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and
AIRCRAFT ENGINEER

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The Outlook

Exalted Straws

NO more significant sign of the times could well be imagined than the recognition of the Royal Air Force expressed in the House of Lords debate on defence policy last week by representatives of the senior Service. THE EARL OF CORK AND ORRERY expressed himself in no uncertain terms: "Our only hope of immediate protection from the advance of the Russians is the Royal Air Force, but that has been allowed to melt away until it will be quite impossible for it to fulfil all the demands that will inevitably be made upon it."

EARL BEATTY went so far as to say: "If our foreign policy is to mean anything at all, I believe we should forget the Channel and the fact that we in this country could shelter behind our position as a Maritime Power. We have got to be a first-line Continental Power in the future. That being the case, although I speak obviously as a naval officer, I feel that all our energies should be bent at this moment upon the Royal Air Force and upon the Army."

An interesting sidelight on the Services was provided by VISCOUNT TRENCHARD, who wanted to see a strong Navy, but in the form of a fleet comprising 1,000 small fast frigates and jet-propelled boats, capable of 30 to 40 knots, to deal with the submarine menace. From such remarks one may take hope that there is now a clear realization of the need for all three Services, but with the R.A.F. as first priority.

This question of priorities was stressed by several Noble Lords, and in the matter of R.A.F. accommodation LORD BALFOUR expressed the views of the Opposition: "We submit that the requirements in housing for the men of the priority Service should have a priority over all others." LORD PAKENHAM, replying for the Government, hoped the unsatisfactory state now obtaining would soon show improvement. But as LORD BALFOUR said, after quoting the Air Minister on the subject of pre-fabricated houses, these have been in existence for the last four or five years, and it does not seem exactly an example of urgency if, in 1949, consideration is being given to them in the Department concerned.

Of other priorities, LORD PAKENHAM said that in research and development the R.A.F. is getting a clear priority this year, and in re-equipment the major measures in 1949 relate to aircraft and associated equipment like radar. Some hundreds of jet machines would, he said, be delivered during the year.

That Elusive Plan

GREAT anxiety was expressed by several Noble Lords concerning the existence of a properly co-ordinated defence plan. VISCOUNT PORTAL spoke with intimate knowledge of what is involved, and he put very clearly the steps that must be taken. First, the Government must have proper control of the Chiefs of Staff machinery, and secondly there must be proper working of the Chiefs of Staff machinery within itself. It was not fair, he said, to the officers who had to plan if they might at any time have their money reduced, or might be suddenly given a large extra sum for the spending of which they had made no plans. An agreement by the Chiefs of Staff was not just a matter of good will; it was a definite duty, and it must be reached, if possible without but if necessary with, intervention of ministerial authority. Disagreement which was not reconciled led to a dangerous state of affairs, as the Ministry of Defence would then have no other course than to attempt with their own staff to formulate a plan and allocate resources.

That remark by Lord Portal deserves to be taken to heart. It states a basic truth, and the Cabinet cannot afford to ignore it. There was no indication in the debate that Lord Portal was, as he expressed it, "push-

ing at an open door," and that a plan has been approved.

So far as the general plan is concerned, all it really boils down to is that Lord Pakenham refused to tell the Lords anything about the short-term plan, while the long-term plan begun with the Brussels Treaty countries must now be harmonized with the wider concept created by the Atlantic Pact.

VISCOUNT SWINTON expressed the feelings of many when he concluded by saying: "I cannot but be profoundly dissatisfied with any evidence I have had of what is taking place." The Government insists on secrecy, not merely in the matter of details, but in the broader aspects. "Of course we have a plan," their spokesmen say, but they will give no inkling of what it is. What a contrast is represented by the United States of America! There a most detailed disclosure is made, not merely in Government circles but in the American Press. *Aviation Week* publishes full particulars of present strength and outlines future plans. And its "Inventory of U.S. Air Power" is prefaced by a statement by Secretary of Defence James Forrestal.

Harbingers

GRADUALLY British civil air transport is, so far as equipment is concerned, beginning to emerge from the doldrums in which it has been drifting for too long. The first of the Canadair Fours for B.O.A.C. was due to arrive at London Airport last Tuesday, and although one swallow does not make a summer, this particular harbinger of spring is extremely welcome. The rest of these aircraft will be coming along in quick succession, and presumably later in the year we shall see the Stratocruisers coming in to supplement the fleet of the Combination Corporation.

There appears to be some delay in delivering the Handley Page Hermes, which should have been emerging from the Radlett hangars by now in a steady stream at the rate of four a month. It is to be hoped that the time lost will be made up later.

As for the more distant future, de Havilland's decision to release in this issue some information concerning the Comet is to be applauded. The makers' desire not to help potential competitors by issuing too many details in advance is understandable, but American journals have made some fairly shrewd guesses, and the time had obviously come when it would have been rather ridiculous to withhold from the British public at least a general idea of what our "White Hope" will be like.

The de Havilland release published on the page opposite indicates that the Comet will, when it goes into service in 1952 or thereabout, be an aircraft worthy to fly the British flag. The designers, known for their cautious conservatism, "hope" for a cruising speed of about 500 m.p.h. at heights above 40,000ft while carrying up to 36 passengers in real comfort and safety.

In the meantime, work on the large Saunders-Roe flying boats of the *Princess* class is progressing according to plan, as recorded elsewhere in this issue. In a totally different way they also promise to be a credit to the manufacturers and to the nation.

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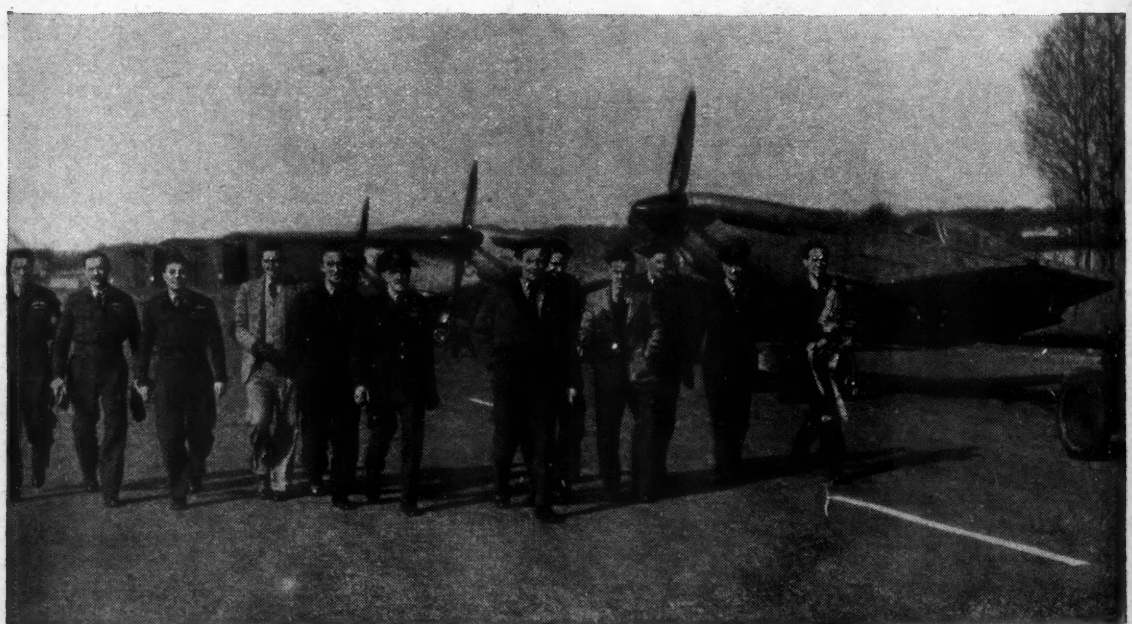


"Flight" photograph.

GOODBYE TO HENDON: Last Sunday two Royal Auxiliary Air Force squadrons moved from Hendon, where they have been located for nearly 25 years, to take up new quarters at North Weald. The two squadrons—No. 601 (County of London), and No. 604 (County of Middlesex)—are equipped with Spitfires and Harvards, but they will be re-equipped with jet fighters at North Weald, where the runways are being extended. Our picture shows pilots of No. 604 walking to their aircraft.

The de Havilland Comet

First Official Disclosures on Britain's Four-engined Jet Airliner

GREAT secrecy has been maintained concerning the new de Havilland D.H.106 which, if all goes well, should make its first flight this year. The new aircraft represents such advanced ideas that it was not considered desirable to give possible competitors any assistance by disclosing general details, an attitude which American manufacturers have accepted in a spirit of friendly rivalry. As the machine has now reached a fairly advanced stage of construction, the de Havilland Enterprise has decided to issue the following information.

The new air liner will be a low-wing monoplane, and the wing will have a moderate sweep-back. The undercarriage is to retract outward, and the nosewheel will be steerable. Because of the large quantity of paraffin fuel to be carried, an underwing pressure-refuelling system will be incorporated which will give a high rate of flow for quick servicing. A fuel jettisoning arrangement will be provided. The main controls will be power operated, and a Smith's electronic automatic pilot will be fitted. De-icing will be of the thermal type.

Simplicity is a characteristic of the D.H.106 which will make a notable appeal as the aircraft takes shape. The absence of airscrews eliminates also their control gear and permits an attractively short undercarriage leg.

The D.H.106 is intended for express services along the trunk routes of the British Commonwealth. It will also be suitable for intercontinental services generally, for it is essentially an airliner for world operation. Its high speed compared with present-day aircraft, besides being an advantage to communications, will materially aid its economy by rendering it possible to fly more miles and carry more ton-miles of payload in the year. But high speed has not been secured at the sacrifice of slow-flying ability; in point of fact the wing loading will be moderate, less than that of some conventional airscrew-driven airliners of the present time, and the stalling speed will be correspondingly modest. Thus, although the D.H.106 will cruise at high speed above the weather, it will be able to descend through cloud steeply at slow forward speed and will circuit, approach and land in the manner of to-day's aircraft. It will not require exceptional runways but will be suitable for operation from normal main airports along the trunk routes. It will, however, require prompt handling by the terminal flight control organizations.

Close Collaboration

Collaboration between the builders and the prospective users of the aircraft, always emphasized in de Havilland experience, has been particularly thorough in the case of the D.H.106. The great background of practical knowledge gathered by British Overseas Airways in the course of many years has been drawn upon, and the other principal operators of the British Commonwealth also have been brought into consultation with good effect. Relations with the Ministry of Supply, Ministry of Civil Aviation, Royal Aircraft Establishment, Air Registration Board, etc., have been clear and satisfactory in every way.

The comfort of passengers when flying at great heights has demanded unprecedented attention to the problems of air conditioning. The aircraft must fly at about 40,000ft in order to achieve optimum economy. The cabin, including the control room, also the luggage, freight and mail stowage, will be pressurized to a differential of 8½ lb/sq in which is nearly double the pressure employed in airliners at present in service. The conditioning equipment includes cooling as well as heating apparatus, also humidifiers to replace the moisture that is absent at such heights. The ventilation air will be changed every three minutes. Air conditioning is typical of the new services which must require a long time to develop to a degree of all-round satisfaction, and it is one of the unpredictables in regard to the date of the first flight and the period of trials. Two

INSPECTING THE COMET: Sir Miles Thomas, chairman-designate of B.O.A.C., visited Hatfield last week to see the D.H. 106. He is seen between (left) Major Frank Halford and Mr. R. E. Bishop.

sections of the fuselage have satisfactorily passed pressure tests in the de Havilland high-altitude chamber at Hatfield, and have been subjected also to underwater tests in a large tank on the airfield, this procedure being adopted to obviate the dangers associated with the possibility of a fuselage bursting. There have been large numbers of individual tests on doors, windows, windscreen, etc. All of this work has been conducted in severe conditions, more stringent than those demanded by the regulations.

Accommodation

The D.H.106 will carry an operational flight crew of four, and up to 36 passengers. The passengers are to be accommodated in fully-reclining chairs with adequate leg room, along the lines of the American "sleeperette," which it is expected will give all the rest that is necessary for the relatively short times which will be spent aloft, even on main-line stages. There will be two toilet compartments, a large luggage room and a modern galley. The aircraft may be expected to show a distinct advance in the matter of freedom from vibration by reason of the employment of jet turbines for propulsion.

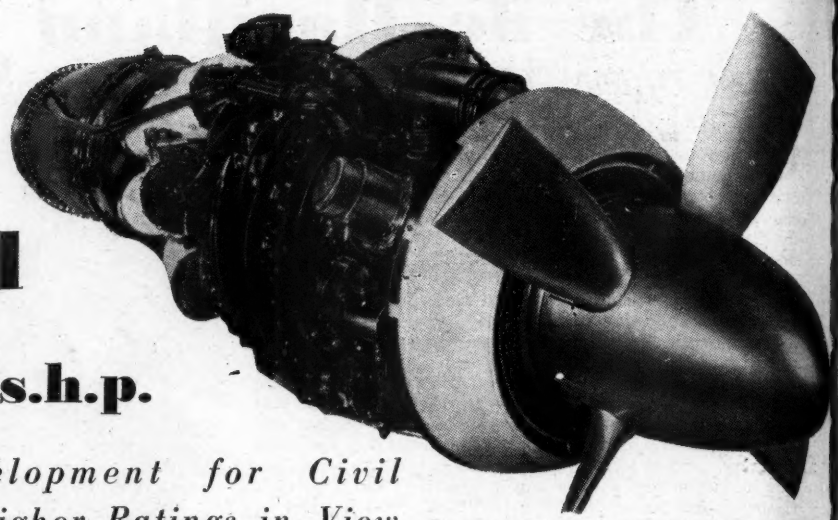
Apart from the speed and simplicity of the jet-propelled airliner, doubtless it represents one of the greatest advances in the matter of reducing the hazards of fire that has been seen so far in the history of aviation.

The de Havilland Ghost engines, of which there will be four, will each give a static thrust of 5,000 lb and on this basis the cruising speed is expected to be something approaching 500 m.p.h. The development of the Ghost engine, for civil and for military purposes, has been most vigorously pressed forward during the past two years under the contractual supervision of the Directorate of Engine Research and Development of the Ministry of Supply. In June, 1948 the Ghost was accorded type approval as a passenger-liner power unit by the Air Registration Board. It embodies all the lessons learned in seven years of running experience with the smaller Goblin engine.

Sixteen D.H.106 aircraft are being built, the first two against contracts for the Ministry of Supply and the remaining fourteen for British Overseas Airways Corporation and British South American Airways. Production of this quantity has been laid down directly from the design stage, a policy which will represent a substantial saving of time on the project as a whole.

Dart Type-Tested at 1,250 s.h.p.

Intensive Development for Civil Installations : Higher Ratings in View



The compressor draws air from the inner annulus behind the spinner. The outer annulus is for the oil cooler.

QUITE rightly, Rolls-Royce turbojets enjoy a high reputation throughout the world. The development of the company's military units has proceeded with top priority for many months past, and it is for this reason that emergence and testing of the Dart turboprop for civil (and perhaps trainer) applications have taken rather longer than might otherwise have been the case. As the new year came in, the Dart RDa.1 completed its full A.R.B. (civil and military) type-test at a maximum rating of 1,250 s.h.p. plus 300 lb thrust. This successful conclusion to the first phase of development, and the very satisfactory performance of the Vickers Viscount prototype airliner with four Dart power units, reflects credit on all concerned. A considerable amount of running with a later mark of Dart, the RDa.3 rated at 1.400 s.h.p. plus 295 lb thrust for take-off, has already been completed. This rating represents a power-to-weight ratio of 1.76 s.h.p./lb.

In spite of the company's preoccupation with the latest marks of Nene, with the Tay, and particularly with the axial Avon turbojet, the Dart will from now on receive plenty of attention in order to be ready to meet a sizeable civil demand, the expectation of which seems well justified by the number and importance of the enquiries so far received.

Descriptions of the principal units of the Dart RDa.1 were given in the December 2nd, 1948, issue of *Flight*, and certain of these components are now illustrated for the first time.

There is a growing belief in this country that turboprops will find important applications in civil aircraft, and it is not out of place to reiterate that Great Britain leads the turboprop field, having no fewer than three different proven types in the 1,000-1,500 s.h.p. class without foreign counterpart, and several others of greater power output.

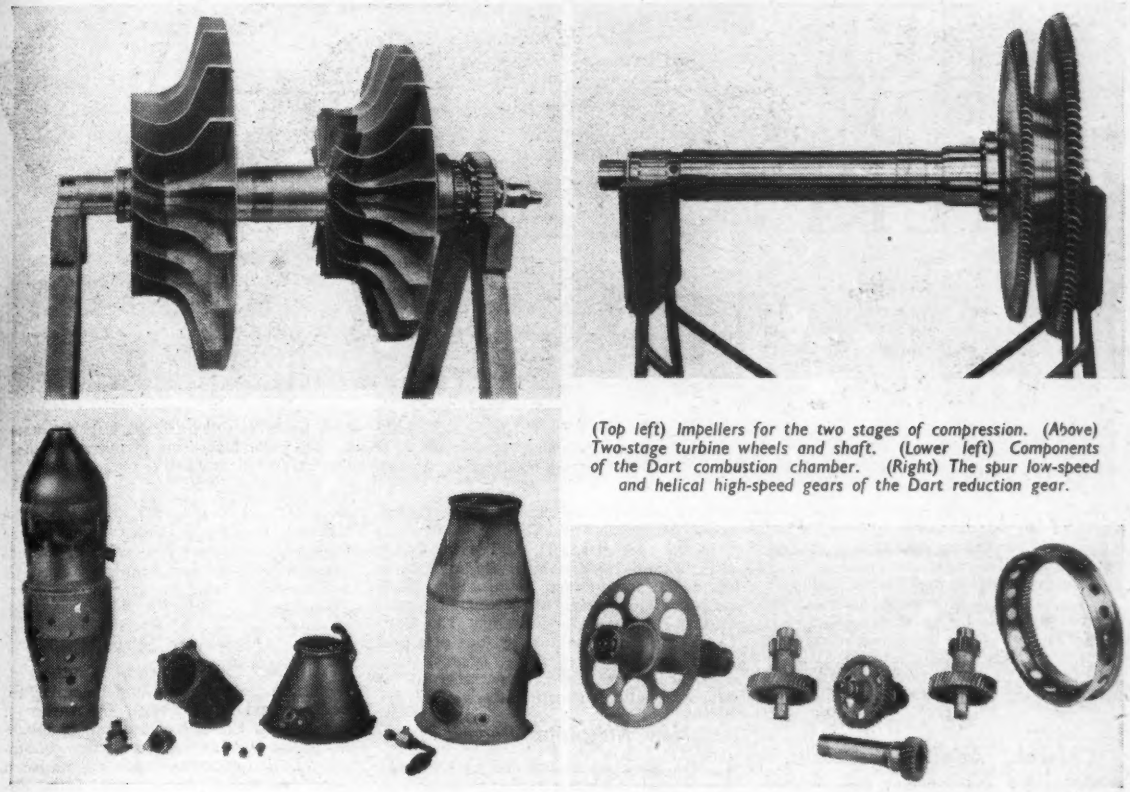
Gaining Operational Experience

In the coming months as much experience as possible will be gained with the Rolls-Royce Dart in order to provide an operational background for airlines which may wish to adopt Dart-powered aircraft to replace certain of their piston-engined machines. The aircraft available for air testing and development are the Lancaster test-bed, in the nose of which the Dart made its first flight; the Wellington test-bed—which, incidentally, preceded the Viscount into the air by only one seven-minute flight, and is now being used by Rolls-Royce at Hucknall; the Vickers Viscount prototype (and later the No. 3 machine, the enlarged Viscount 700); and, finally, the Avro Athena trainer in which a Dart has been installed but which, at the time of writing, has not yet flown.

The unusual arrangement of combustion chambers and the use of a two-stage centrifugal compressor have enabled the Dart to be kept short and compact. The oil tank is cast integrally with the air intake casing.

Flight development has proceeded very smoothly so far and looks as if it will continue to do so. Reduction-gear problems had already been "ironed out" (on the Clyde) and the present straight spur gears for the low-speed, and helical gears for high-speed, trains have proved satisfactory. They were stressed up to the present type-test power and the design of the reduction gear conforms, generally speaking, to that which has become standard practice for this type of power unit. In the higher-powered Dart RDa.3, helical gears will most probably be used for both low- and high-speed trains.

Control of power and pitch had been studied on earlier



(Top left) Impellers for the two stages of compression. (Above) Two-stage turbine wheels and shaft. (Lower left) Components of the Dart combustion chamber. (Right) The spur low-speed and helical high-speed gears of the Dart reduction gear.

Rolls-Royce turboprops, notably the Trents in the special Meteor. The Dart single-lever power control has not yet been entirely finalized, a temperature control which is to be incorporated in the system being still under development. The power lever is mechanically linked with the fuel-supply control and the airscrew c.s.u. A cam system takes care of the higher range of engine speeds, and it is this device which is to be replaced by the temperature control to look after all speeds. Briefly, the purpose is to provide the engine with all the fuel it needs for maximum power but to prevent excessive fuel flow due to additional opening of the throttle after the maximum r.p.m. position has been selected through the c.s.u. linkage. The problem is to provide for air temperature variations, and the cam is now set for a representative sea-level atmospheric temperature of 20 deg C. The maximum turbine temperature for normal running is 550 deg C, and the two-stage turbine is guarded by the usual excess-temperature and overspeed devices which over-ride the controls and restrict fuel flow in emergency.

Feathering is achieved by moving the high-pressure fuel cock through a gate past the fully-closed position. This interlinking is, of course, to prevent any possibility of burning the engine out due to feathering while fuel is still being supplied.

The problem of reduced thrust resulting from quick throttle opening with concurrent rapid pitch-change leading to engine-speed increase has been overcome by reducing the rate of airscrew pitch-change. There is no dashpot delay device, or anything similar, in the system. The "throttle" can be opened rapidly from idling (6,000 r.p.m.) and the blade pitch then changes at a rate which matches suitably the increase in fuel flow and engine speed.

The Rotol airscrew is fitted with the maker's own fine-pitch stop. Starting pitch is zero degrees, and flight fine-pitch is at present 22½ deg; this figure may later be increased to 25-27 deg. The fine-pitch stop is withdrawable and is controlled by load on the wheels or by the pilot's over-ride switch. Re-engagement is automatic on take-off. A safety device is incorporated to prevent the airscrew from moving into zero or reverse pitch unless the weight of the aircraft is on the undercarriage. Airscrew braking is obtained on landing by moving the throttle lever through a gate: this movement operates a switch and solenoid valve, causing the blades to move into reverse pitch.

Take-off Power for the Viscount

Before leaving the subject of airscrews, it is of interest to note that, so far as the Viscount is concerned, airscrew diameter may be a limiting factor in the power output of its four Darts. The present size is suitable for powers up to the 1,400 s.h.p. of the RDa.3. To fit a larger (No. 5) shaft to the Dart to carry a bigger cropped airscrew would add some 60 lb weight per engine and would hardly be worth while.

It is for reasons of power absorption that water/methanol injection, for which the Darts are equipped, is only recommended for re-establishing full rated take-off power when operating from high-altitude fields or in tropical temperatures. The possible power boost resulting from injection (via a ring of holes into the first-stage impeller) is about 400 s.h.p. with a 10 deg temperature rise.

Some advances have been made in the starting system for the Dart. It has been found possible to eliminate the low-voltage take-up and to save about 7 lb weight by incorporating a Rolls-Royce slipping-type clutch in the starter drive. A B.T.H. electric starter is employed.

A large number of relights have been made in the air, and there has not been a single failure to date, even though trials have been made as high as 35,000ft.

Icing trials are to be undertaken with the Dart-Lancaster. Preliminary investigations with Rolls-Royce units having centrifugal compressors have revealed no susceptibility to damage by ice. On one occasion one-inch cubes were shovelled without adverse effect into the intake

(Concluded on page 377)

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FIRST FREE FLIGHT: The French SO 1100, which made its tethered tests last May, has now "come off the ropes," as this picture shows. The rotor blades are jet-propelled, the engine driving a compressor which supplies the fuel/air mixture to the jets.

A.T.A. Memorial

THE Dean and Chapter of St. Paul's Cathedral have granted permission for the erection in the crypt of a plaque to commemorate the 173 men and women of Air Transport Auxiliary who gave their lives in the war.

Vampire Tour Ends

DURING the past 14 months a Vampire 3, piloted by F/L. G. Francis, A.F.C., has been demonstrated in most of the countries of the Pacific and Far East during the course of performance trials. Last week-end it made a 6,000-mile staging flight from Singapore to Khartoum. Humidity trials have been completed and, after dry-heat tests, the Vampire will be dismantled and shipped to England for examination. A photograph of the aircraft and its pilot and servicing crew appeared in the Jan. 27th issue of *Flight*.

Chinook: Additional Details

CANADA'S development axial turbo-jet continues to make good progress. To the details included in our description in *Flight* of January 22nd, 1948, have been added the following figures: climb rating at 9,800 r.p.m. S.L. static, 2,100 lb; cruising at 9,500 r.p.m. S.L. static, 1,900 lb; fuel consumption 1 lb/lb thrust/hr; oil consumption 2 lb/hr; length 125.1in. It will be remembered that the diameter is 32in, the weight 1,250 lb and the maximum take-off power 2,600 lb thrust at 10,100 r.p.m.

Rapid Rescues

DURING the naval/air exercises off Plymouth last week which concluded the Home Fleet's winter cruise to the Mediterranean, two Naval pilots "landed" in Plymouth Sound and were swiftly picked up by air-sea rescue launches.

In the case of Lt. D. A. Berrill, flying a Firebrand from H.M.S. *Implacable*, a rescue launch arrived so promptly that he was able to step from the sinking aircraft with barely a wetting. Lt. Cdr. D. C. F. Gibson, who baled out of a Sea Fury from the carrier *Theseus*, was slightly less fortunate, but was saved by a second launch shortly afterwards.

New Helicopter Record?

LAST week we mentioned that an unofficial helicopter record was claimed for the Piasecki XHJP-1 helicopter, which was said to have done 131 m.p.h. over a measured course. Now comes news that a Bell XH-12 of the U.S.A.F. has been timed to do an average of 133.9 m.p.h. over the 5,000ft runway at Niagara Falls airport. The record is, of course, unofficial until homologated by the F.A.I. The official world's record is at present held by the Fairey Gyrodyne at 124.3 m.p.h.

B.S.A.A. Employees' Protest

SHORTLY after the announcement of the proposed absorption of B.S.A.A. by B.O.A.C., employees of the former Corporation organized a protest meeting at the Caxton Hall, London. The chairman, Mr. G. T. Cupat, a London Airport engineer, said that the meeting wanted to bring home to the public "the tremendous folly of swamping a small and successful B.S.A.A. by a large and comparatively unsuccessful B.O.A.C."

INDIAN INSPECTION: A.V-M. Willock, C.B., Civil Air Adviser Designate to the U.K. High Commissioner in Australia, offers a hand to G/C. Shiv Dev Singh, Air Adviser to the High Commissioner for India in the United Kingdom, as the Group Captain descends from an Avro Athena T.1. G/C. Singh was accompanied by S/L. Gokal, and both officers flew with Mr. J. Baker in the new Mamba-powered trainer.

New Air Surveys

DURING the next eight months Oldham, Nottingham and Leicester will be surveyed from the air by Ansons of the R.A.F. Central Photographic Establishment. New Ordnance Survey 50in-to-the-mile maps of the areas will be based upon the aerial photographs. Rural districts in Essex and Nottinghamshire are also to be filmed for 25in-to-the-mile maps.

The Ansons will employ the Decca Navigator system, the advantages of which, for air-survey work, were summarized in *Flight* last week. New maps to be produced from the results of the surveys may not be available for several years, and the developed films are therefore stored at a constant temperature to prevent distortion.

Pegg Prepares

ACCORDING to a report from Fort Worth, Texas, Mr. "Bill" Pegg had, by last week-end, logged seven and a half hours of flying the Convair B-36 bomber. An earlier report had stated that Mr. Pegg would gain such experience, in preparation for the first flight of the Brabazon, on the XC-99, transport version of the B-36.

It is expected that he will complete 15 to 20 hours on the B-36 before returning to this country next month. The normal loaded weight of the Brabazon I is 279,000 lb—1,000 lb heavier than that of the B-36. Wing spans of the two machines are equal (230ft) but the 177ft fuselage of the Brabazon is 14ft longer than the B-36's.

Swift Stalking

AN American sporting journal has disclosed a most unusual application for the Lockheed RF-80—photographic version of the Shooting Star—which has three vertical cameras mounted in the nose. With the advantage of a relatively silent approach at high speed, the aircraft is being used to survey the number of ducks in the San Joaquin Valley, Cali-

HERE AND THERE

fornia. Photographs are taken at 400 m.p.h. from a height of 300ft before the fowls have time to disperse.

Solo Record

THE National Aeronautics Association of America records that Capt. Bill Odom's flight in a Beechcraft Bonanza from Honolulu to Teterboro, New Jersey, on March 7th-8th was the longest non-stop solo flight ever made, covering 4,957.25 miles. Previous records were Mr. Charles Lindbergh's 3,609-mile New York-Paris flight in 1927, and the 3,942 miles flown by the late Wiley Post from New York to Berlin.

Delta Details

ALTHOUGH the original design was to have had a maximum speed of 1,165 m.p.h., the delta-wing Convair 7002, which was illustrated in *Flight* of March 3rd, will be used by the U.S.A.F. to investigate control and stability problems at speeds up to 400-450 m.p.h. Power for the 7002, which now has a J-33 turbojet of 5,200 lb s.t., was to have been provided by a ramjet-rocket combination. With fuselage fuel tankage only, present endurance is about 30 min.

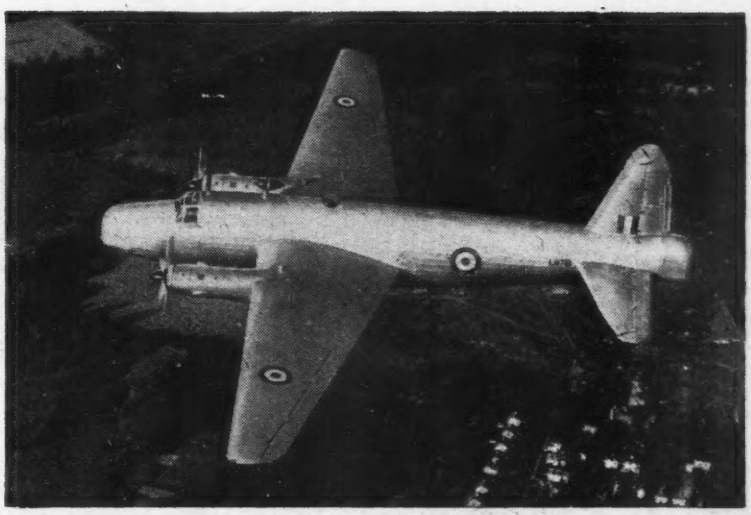
Aerial Crop-sowing

A GRUMMAN Avenger of the R.N.Z.A.F., directed by radio from the ground, recently sowed 50 acres of land at Sanson, New Zealand. The experiment was undertaken by the R.N.Z.A.F. in conjunction with the Soil Conservation and Rivers Control Council, which plans large-scale aerial sowing of hilly country in the Wairapa district; in this instance Miles Aerovans will be used.

End of a Veteran

MANY wartime memories will be recalled by the news that the last Whitley is being broken up at Baginton. The Whitley was the first heavy bomber to operate against the enemy in the last war, and also gave good service in widely different duties, including para-troop-dropping, operational training and patrols with Coastal Command.

The last Whitley was never in action but was used for towing the Armstrong Whitworth 52G tailless glider. A Lancaster will be employed to continue the 52G test programme.



THERE'S POWER IN THEM THAR CURVES: The thorough checking of performance estimates for its two Rolls-Royce Darts is the present work of this special Wellington "test bed" which is now being operated from Hucknall. The scoops seen around the nacelles have been eliminated on later installations, it having been proved that the hot sections of the power units do not, after all, require a flow of cooling air. Pegasus, Merlin and Hercules engines and (experimentally) a tail-installed Whittle turbojet and now the Dart turboprop, have all provided power for Wellingtons.

U.S. Nomenclature

A PROPOSAL by the McDonnell Aircraft Corporation that its XF-88 penetration fighter should be given the name "Voodoo" is reported by *American Aviation* to have been turned down by the U.S.A.F., on the grounds that only production aircraft should be named. The North American F-86 fighter will be known as the Saber (*sic*), and the titles "Apache," "Tornado," or "Challenger" have been offered to North American for its B-45 four-jet bomber. Members of the bombing wing which will be equipped with B-45s made the choice.

Rolls-Royce and Commonwealth

FURTHER details of Rolls-Royce participation in the Commonwealth Aircraft Corporation of Australia briefly referred to in these columns last week, show that the total value of the shares taken up is £70,000, equivalent to a holding of approximately 10 per cent in the issued capital of the Corporation. The wartime productions of the Australian company included Merlin engines and the experimental Griffon-powered C.A.15 fighter; now, as already stated, it is manufacturing the Nene turbojet under licence.

Joint Effort

RECENT official figures show that British and Dominion aircraft operating on the Air Lift have carried just under a quarter of the supplies flown into Berlin. American aircraft were responsible for the remaining three-quarters.

Goods flown out of Berlin since the Air Lift began last June include 25,000 tons of German mail and industrial exports. The daily average of cargoes flown into the city last month was 5,610 tons—a 1,350-ton increase on the January figure.

News in Brief

THE first six-month course, for 15 officers under A. Cdre. U. E. Ewart, at the new R.A.A.F. Staff College, Laverton, Victoria, will begin in May.

* * *

The Douglas, Lockheed and Martin Corporations are reported to have begun "casual" discussions with U.S. airlines regarding the development of jet transports.

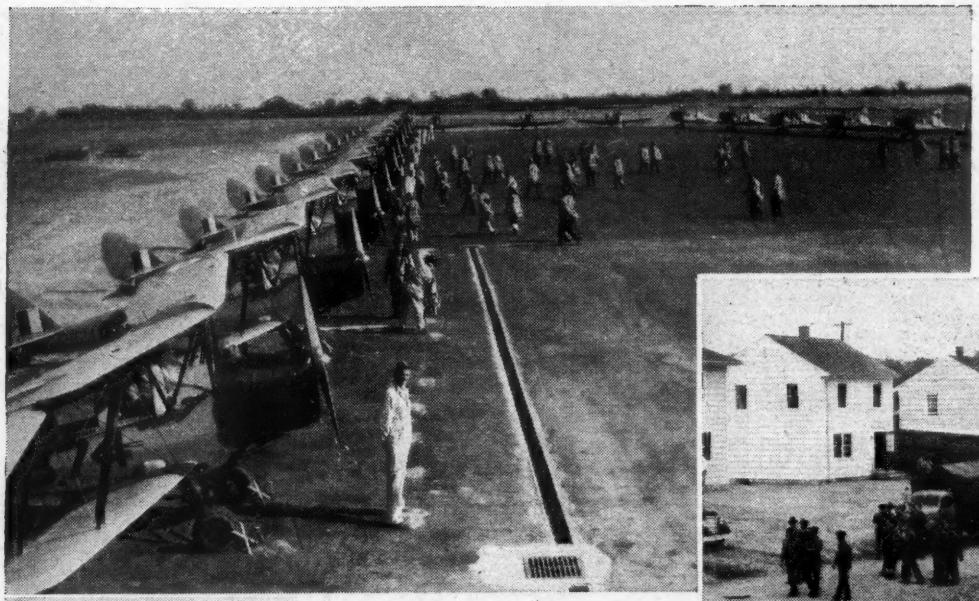
* * *

On Friday, April 8th, the de Havilland Aeronautical Technical School is to hold a 21st-anniversary ball at the Hyde Park Hotel, London. Double tickets (44s) are obtainable from the organizing secretary, Mr. R. P. Kent, de Havilland Aircraft Co., Ltd., Hatfield, Herts.

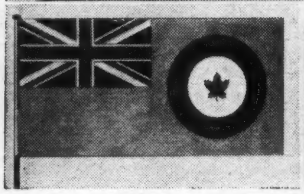
* * *

The Aerauto Association is holding a "get-together party" on Saturday, April 2nd, at 7.30 p.m. at the Rose and Crown, Park Lane, London, W.1. Former students of the Colleges of Aeronautical and Automobile Engineering Chelsea, and their guests may obtain tickets (3s 6d each, including buffet) from H. A. Craw, 30, Cranley Gardens, London, S.W.7.

IN SHORT SUPPLY: The housing shortage was one of the most serious considerations for personnel involved in the transfer of Short Bros. activities from Rochester to Belfast. In fulfilment of a promise, Short Bros. and Harland, Ltd., have erected 121 houses—some of which are seen here—in and around Belfast since March, 1947.



(Left). *Tiger Moths and trainees : a flash-back to the days of the Commonwealth Air Training Plan, which produced over 130,000 aircrew. (Below). These modern married quarters were among 1,833 in existence by the end of 1948.*



CANADIAN JUBILE

R.C.A.F. Activities Over a Quarter of a Century

THE eve of the twenty-fifth anniversary of the Royal Canadian Air Force seems an opportune moment to express appreciation of the splendid service in the air given by Canadians in the course of two wars. The occasion is appropriate also for a brief review of the evolution of the Dominion's Air Force, which is so akin to our own in both tradition and organization.

Although the birthday of the R.C.A.F. is now officially accepted as April 1st, 1924, when it became a permanent component of Canada's defence forces, the Service as such had actually existed for over a year. The force's foundation stone was laid in 1914, when the Canadian Aviation Corps came into being; it consisted of two officers and one aircraft. Although no independent Canadian air force flew in the first World War, some 22,000 Canadians served in the R.F.C., R.N.A.S , and finally the R.A.F.; about 14,000 became pilots. Late in 1918, two all-Canadian squadrons were formed within the R.A.F., but the war ended before their training could be completed.

In June, 1919, an Air Board was formed to control all flying in Canada. One of its first recommendations was that a non-permanent, non-professional Air Force should be formed. The resulting body was the nucleus of the R.C.A.F. as it is known to-day, but its first activities consisted only of 28-day refresher courses, held at Camp Borden, one of the first Canadian airfields. By 1923, the force occupied four stations, of which Camp Borden remained the training centre and H.Q., while the Vancouver, Winnipeg and Dartmouth airfields were bases for survey, forest patrol, and anti-smuggling flights. When the service received the prefix "Royal" in February, 1923, its duties were mainly civilian rather than military. It is of interest to recall that the Controller of Civil Aviation at that time was S/L. L. S. Breadner, D.S.C.—later Air Vice-Marshal Breadner, Chief of Canadian Air Staff, and now retired.

The first establishment figures for the permanent R.C.A.F. in 1924 showed a total of 68 officers and 307 men. Its aircraft were mainly wartime R.A.F. types—Avro 504K, S.E.5a, D.H.9a, Sopwith Snipe, and Bristol Fighter. The first post-war aircraft orders were for eight Vickers Viking IV flying-boats.

Numbers of men and machines increased steadily up to 1923-33, when a national depression caused a drop in financial allocations and about one-fifth of the R.C.A.F. personnel were discharged. The Service recovered from this bleak patch, however, and dropped some of its civil commitments, concentrating more on military training. In 1933 the first three squadrons of the Auxiliary Air Force were formed at Toronto, Winnipeg and Vancouver under the title of the Non-Permanent Active Air Reserve, and by 1935 four more squadrons had been added.

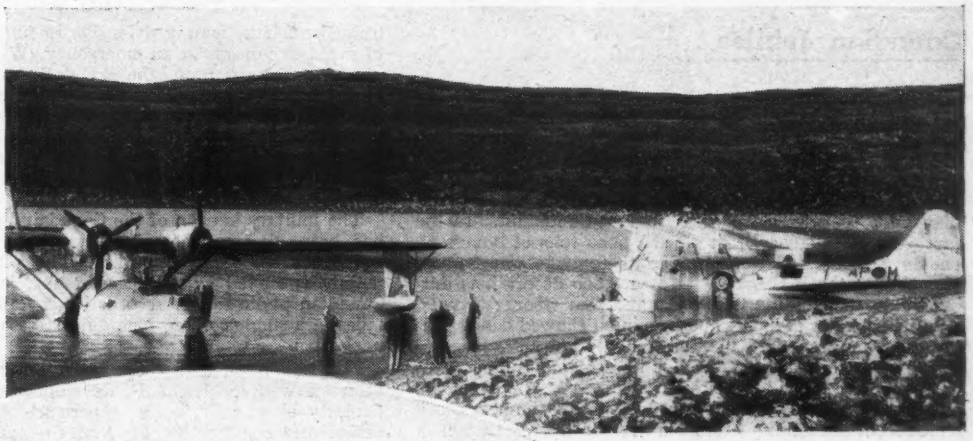
Darkening of the political horizon in 1938, with its resulting expansion of European air forces, was reflected by important changes in R.C.A.F. organization, which brought its construction into closer conformity with that of the R.A.F. A Chief of Staff was appointed, so that the R.C.A.F. became an independent service under the Minister of Defence, instead of the Army Chief of General Staff.

Diversity of Types

When war broke out in September, 1939, aircraft in service were extremely varied, including types as dissimilar as the Armstrong Whitworth Siskin and the first Canadian-built Hurricanes. There were ten active R.C.A.F. squadrons, some still being formed, and personnel strength was about 4,000 officers and men, a total that was multiplied by more than fifty before war had ended.

Canada's contribution to the air war was two-fold. The gigantic Commonwealth Air Training Plan produced more than 130,000 trained aircrew members, over half of them Canadian, between 1941 and 1945. The first Canadian

(Right). Rugged Arctic terrain, such as that on Melville Peninsula, is typical of surroundings familiar to the crews of R.C.A.F. Canso amphibians. These aircraft are the Canadian-built amphibian version of the Catalina.



Search and rescue are among the R.C.A.F.'s most essential peacetime commitments. The Dakota on the left is evacuating a casualty from Baffin Island, Arctic Bay.

(Above). Responsibility for Dominion defence rests largely on the auxiliary squadrons. No. 400 (City of Toronto) Squadron is one of five Vampire-equipped units.

(Left). A wartime inspection by H.M. the King of members of the R.C.A.F. Women's Division—last of the three Canadian women's services to disband.

Canadian Jubilee . . . . . .

Squadrons to arrive in Britain in 1940 were No. 110 (City of Toronto) Squadron, followed by No. 1 Fighter Squadron, which flew in the Battle of Britain, and No. 112 (City of Winnipeg) Squadron. Further Canadian fighter, bomber and coastal squadrons were formed and went into action in 1941, and in January, 1943, No. 6 Group, an all-Canadian unit, took its place with Bomber Command. In the first year of existence it dropped 13,000 tons of bombs on enemy targets, and during 1944 its tonnage was 85,000. Members of the R.C.A.F. won over 8,600 decorations during the war, including two V.C.s and four George Crosses.

In its post-war planning the Dominion showed determination that the peacetime Air Force should not be reduced to impotency, while a decrease from its wartime numbers was obviously necessary. Its present strength is about 14,000, but recruiting is to continue, unrestricted by the previously announced maximum establishment of 16,100, when a further 2,000 officers and men were also authorized to cover the R.C.A.F.'s air-sea rescue and photographic survey commitments.

The present role of the Service is that of a small and well-trained nucleus, mainly defensive in function, but capable of rapid expansion in an emergency. With an accent thus placed on interception, the R.C.A.F. was one of the first overseas buyers of the Vampire, which now equips five of the ten auxiliary squadrons. Negotiations are also being made concerning production, within the Dominion, of the North American F-86, and similar arrangements may be made to supply the R.C.A.F. with Fairchild C-119 Packet military transports.

The military version of the Canadair Four, the C-54-GM, has been giving excellent service to R.C.A.F. transport squadrons for many months. The photographic units, mainly equipped with Lancaster 10s, last year broke all Canadian photo-survey records by covering 911,000 square miles in a single season, including large areas of previously uncharted land.

Post-war progress by Canadian aircraft manufacturers promises well for R.C.A.F. development prospects. Particularly significant is the experience gained in turbojet design and construction by Avro-Canada, which has produced the Chinook, and, more recently, the Orenda. An experimental twin-jet fighter from the same stable, designed for all-weather defence, may prove to be a mainstay of the R.C.A.F. in the future.

GERMAN HELICOPTERS

Wartime Research Reviewed in a B.I.O.S. Report

BRITISH progress in helicopter development has been such that one is apt to overlook the fact that, to all intents and purposes, it began after the end of the war. All the more remarkable, therefore, that so much has been achieved in so short a time.

While we in this country neglected rotary-wing research, the Germans devoted considerable time and money to it. Just how much is clearly indicated in British Intelligence Objectives Sub-Committee Overall Report No. 8, entitled *Rotating-wing Activities in Germany during the Period* 1939-1945. The author is Captain R. N. Liptrot, C.B.E., M.A., Deputy Director of Research and Development at the Ministry of Supply, than whom no one could be better qualified to compile such a document. From the earliest days Capt. Liptrot has taken the very keenest interest in rotating-wing aircraft, and before the war he was in close touch with experimenters in Germany and other countries. After the war he visited Germany and talked with many of the German workers who were engaged on the theory and practice of rotating-wing development. The results are admirably set out in B.I.O.S. Overall Report No. 8. The document is obtainable from H.M. Stationery Offices, price 3s net, and it is very good value for the money to anyone interested in the subject.

Readers of *Flight* will no doubt remember the interest caused by the Focke-Wulf type 61 helicopter some years before the war, when it established world's records and, somewhat spectacularly, was flown *inside* a large building, the Deutschlandhalle by Hanna Reitsch. That was the world's first really practical helicopter, and there is no doubt that the success it achieved encouraged wartime development of rotary-wing aircraft.

The 61 was not really a Focke-Wulf product but a Focke-Achgelis. As Capt. Liptrot points out, Heinrich Focke was displaced from his position as chief of the Focke-Wulf concern by the Nazis because he was "politically unsafe." He then joined forces with Herr Achgelis, a German pilot whose aerobatic performances were demonstrated in England before the war. Capt. Liptrot has a good deal to say about the Focke-Achgelis types of helicopter developed during the war, and he remarks, concerning the Fa.223, that in spite of certain faults "it met, with considerable success, a specification which is only now being approached by other manufacturers."

Another helicopter which was very advanced, and which did more flying than any other, was the Flettner Fl.282; a small machine with transverse intermeshing rotors, an arrangement which had previously been suggested by Dr. Bennett and the Cierva Autogiro Company and first tried out in an earlier Flettner, the Fl.265. Production plans were for 1,000 Fl.282s, but Allied air attacks delayed matters and actually only 22 were completed.

Friedrich Doblhoff, an Austrian experimenter, built several helicopters with jet-propelled blades. A compressor driven by the engine supplied the air, which was mixed with fuel and piped to the jet ducts at the blade tips. Fuel consumption was high, but Doblhoff's intention was that the jets should should be used only for take-off and climb, the airscrew then being clutched-in and the machine flown as an Autogiro.

Very small helicopters were tried by several experimenters. Bruno Nagler, a former collaborator of Raoul Hafner's, experimented in Austria in association with Franz Rolz. Several models were built, a feature being single-bladed rotors with the engine serving as a balance weight.

Paul Baumgartl, another Austrian, built and experimented with strap-on Autogiros and with small harness-type helicopters. The latter had two co-axial, superimposed, blades, each with an 8 h.p. engine as its counterpoise and power plant.

A rather clumsy contraption was designed and produced by the A.E.G. company. It was intended as a tethered helicopter observation platform, and did not really go much beyond the Karman-Petroczy type of the 1914-18 war.

More spectacular than any of these was the project suggested by Kurt Tank, chief designer of the Focke-Wulfe company. He proposed an aircraft in which the three-bladed rotor was mounted around a circular-section fuselage, take-off to be with the fuselage vertical. There were to be propulsive ducts at the blade tips and rockets for starting. The calculated maximum speed at sea level was 620 m.p.h. and 520 m.p.h. at 36,000 ft.

All these interesting experiments and projects are described in considerable detail, and numerous photographs and drawings illustrate the variety of ideas among German experimenters. Some of these themes may well be worth developing, and B.I.O.S. Overall Report No. 8 discloses many of the pitfalls which could be avoided by experimenters of the future.

IMPROVED FLUORESCENT CABIN-LIGHTING

A SECOND Avro York for service on the B.S.A.A. (or B.O.A.C.) Miami-Nassau route has now been equipped with fluorescent cabin-lighting. Various changes have been made in comparison with the previous installation, notably the use of the new G.E.C. type FM 2416 lighting fittings, and the choice of "natural" in place of daylight-colour Osram lamps.

Eight of the 12 fittings in the cabin are so arranged that a virtually unbroken line of light along the centre of the ceiling is obtained, the ends of the clear reeded Perspex bend which encloses the lamp in each fitting being of high-transmission opal Perspex. The other four cabin fittings are placed two on each side of the cabin at the aft end. In addition, one fitting is installed vertically between the toilet doors to light the entrance vestibule.

The lighting supply is derived from a rotary converter operating on the aircraft 24V system and giving a three-phase, 400-cycle output at 110V. Pirelli-General civil aircraft cables are used throughout for wiring the fluorescent installation.

TAILLESS TWINS

New Comparative Data on the Two Versions of the A.W.52 Research Aircraft

OF recent years an entirely new class of aircraft—that built entirely for research—has established its own distinct and important niche in aviation. While the first appearance (or some extraordinary achievement) of such a machine may bring a brief spell of limelight, the far-reaching results of experience and information acquired in stringent testing programmes may not become apparent for many years.

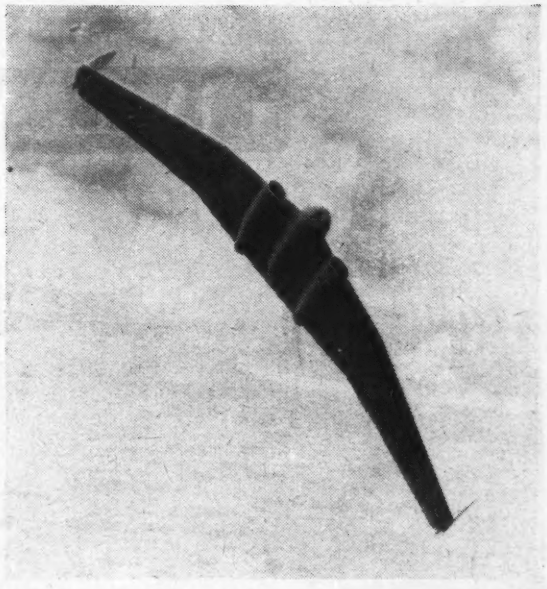
This is particularly true of the Armstrong Whitworth A.W.52, a tailless research aircraft bristling with aerodynamic novelties. Itself preceded by a glider of similar configuration, the A.W.52 is not only the forerunner of tailless airliners and bombers, but is also making an invaluable contribution to knowledge of design problems peculiar to the flying wing.

Data lately released provide an interesting comparison between the weights and performance of the two versions of the A.W.52 now flying; a summary of the main details is presented in tabular form below. The first aircraft, which made its initial flight in November, 1947, is powered by two Rolls-Royce Nene turbojets, each of 5,000 lb static thrust, a total 3,000 lb in excess of that provided by the two Derwents installed in the second machine, which has now been flying for some months. Apart from the jet installations, there are few differences between the two aircraft, as observers at the 1948 S.B.A.C. Display at Farnborough will testify.

A.W.52 DATA

	Nene Version	Derwent Version
Dimensions		
Span	90ft	
Length	37ft 4in	
Height	14ft 5in	
Weights and Loading		
Structure	11,083 lb	11,164 lb
Power plant	6,190 lb	5,500 lb
Equipment	2,389 lb	2,521 lb
Weight empty	19,662 lb	19,185 lb
Crew (2)	400 lb	400 lb
Mail or Freight	4,000 lb	4,000 lb
Fuel and Oil	10,092 lb	9,720 lb
Gross weight	34,154 lb	33,305 lb
Wing loading	25.1 lb/sq ft	24.7 lb/sq ft
Power loading (based on 2½ lb thrust/b.h.p.)	8.25 lb/h.p.	11.6 lb/h.p.
Performance		
Max speed	500 m.p.h.	450 m.p.h.
Cruising speed	330 m.p.h.*	330 m.p.h.†
Service ceiling	50,000 ft	45,000 ft
Still-air range at 36,000 ft:		
Cruising	1,500 miles	1,500 miles
Max	2,130 miles	2,130 miles
Initial rate of climb	4,800 ft/min	2,500 ft/min
Initial rate of climb with one engine	1,500 ft/min	480 ft/min

* At 15 per cent of max sea-level thrust.
† At 21 per cent of max sea-level thrust.



Airborne, the two A.W. 52s are indistinguishable, except, perhaps, by past-grand-master spotters or A.W.'s experimental staff. Shown (we believe!) is the Nene-powered variant.

The very favourable impression made by an aerial demonstration of the Nene-powered "Wing" on that occasion was heightened by the flawless finish of the aircraft. This is far from being mere decoration, but is, in fact, an essential complement to the machine's exceptional aerodynamic cleanness, with its laminar-flow, swept-back wing employing a novel boundary-layer-suction system to counter tip-stalling and stick force-reversal effects.

For details of the A.W.52's remarkable construction and control system, reference should be made to the descriptions published in *Flight* of December 19th, 1946, and January 15th, 1948. Information on present research equipment fitted shows that photographic recorders are provided, and anti-spin parachutes are packed in wing-tip containers. A V.H.F. radio set, type TR1464, is installed, and provision is made for an AR15083 Gee indicator.

Differences in performance due to the power output of the two versions shown by the accompanying table are mainly self-explanatory. It is of interest to note, however, that the more powerful installation confers increases in maximum speed, and, notably, initial rate of climb. Range is the same for both machines.

LIGHTWEIGHT TURBOJET

ONE of the smallest jet units to follow normal axial-flow layout, the Flader J-55 turbojet, is now in production for the U.S. Air Force. Producing 770 lb thrust for take-off, the J-55 was probably designed for powering pilotless aircraft, but it is claimed that application to a five-seat commercial aircraft would give a cruising speed increase of 100 m.p.h.

With a standard tail-pipe the length of the unit is 79in, and overall diameter is 15¾in. With starter, fuel pump, and engine controls, the J-55 weighs only 300 lb. For cruising it produces 700 lb thrust at 26,000 r.p.m., its axial compressor aspirating 15.4 lb of air per second at a compression ratio of 2.85.

A second Flader design, which is under development for the U.S.A.F., is the XT-33 turboprop. This is believed to have been designed for an output of 7,500 h.p., and incorporates a multi-stage axial-flow compressor and turbine and an adjustable tail-pipe bullet. A planetary reduction gear drives a contra-rotating airscrew.

COST OF CONVERSION

IN his 26 years with Hawker Aircraft, Ltd., Mr. Sydney Camm C.B.E., F.R.Ae.S. (chief designer), has been responsible for some outstanding naval aircraft, and in the current issue of the *Hawker-Siddeley Review* he discusses the development of the naval fighter.

Especial interest attaches to a table in which he compares the weight increases entailed in "navalizing" a typical piston-engined fighter and a typical jet-fighter. Due to the absence of airscrew slipstream, the latter aircraft requires special flaps for lift and drag control, accounting for nearly half of the estimated extra 900 lb acquired by the jet aircraft.

Total increase quoted by Mr. Camm for the airscrew-driven fighter is 425 lb, which is composed of such items as arrester gear (26 lb), R.A.T.O.G. and A.T.O. fittings (26 lb), fuselage strengthening (22 lb), undercarriage strengthening and provision for increased absorption (42 lb), and operational equipment (105 lb). Corresponding additions to the hypothetical jet-fighter are given as 64 lb, 35 lb, 47 lb, 87 lb and 240 lb respectively.

CIVIL AVIATION NEWS

Corporations' 1948 Traffic : London Airport Progress : Turnhouse Again

FIRST STOP SICILY : A B.O.A.C. Sandringham on the Far East service is warped into the passenger disembarkation dock at Augusta.

THE CORPORATIONS' YEAR

ALL-ROUND increases in traffic figures are shown in the analysis of 1948 operations by the three Corporations, issued last week. Total aircraft mileage flown amounted to 44,049,223, an increase of 12.9 per cent over the 1947 figures. Individually, B.E.A. disclosed a 7 per cent increase, B.O.A.C. 14.5 per cent and B.S.A.A. 20.1 per cent.

Passenger mileage totalled 555,362,064. This was a 26.5 per cent increase, B.E.A. showing the largest gain with 39.1 per cent; B.O.A.C. and B.S.A.A. had percentage increases of 24.1 and 11.5 respectively.

Mail ton-mileage increased to 9,945,613 (20.8 per cent up), B.E.A. showing easily the largest gain with 74.4 per cent. Freight ton-miles amounted to 15,631,281 (53.5 per cent gain), the biggest increase in this category being that of B.O.A.C., with a figure of 70.3 per cent.

Issued at the same time, the December, 1948, figures show a combined passenger mileage of 42,311,274, an increase of 17.6 per cent over the total for the corresponding period of 1947. Under only one heading is a falling-off recorded: B.S.A.A. freight dropped from 358,925 ton-miles to 304,523.

We intend to review the figures in greater detail next week.

LONDON AIRPORT PROGRESS

IN a report on progress made and developments envisaged at London Airport, the Aerodrome Commandant states that during 1948 traffic maintained a steady increase. Passenger figures totalled 385,000 for the year, an increase of more than 100,000 over the previous year. Sixteen airlines operated through the Airport and during 1949 there will be 17, as Air Ceylon is coming in.

During the year great improvements were made in the departure hall, which included bookstalls, buffets and bars in addition to the normal ticket counters and enquiry bureaux. Further improvements are in progress and will be ready by the summer, including a restaurant for passengers and their friends, with large windows overlooking the aircraft apron; twin channels through the airport controls, on both the arrival and departure sides, to eliminate any possible bottleneck in passenger-handling; and barber's shop, florist, and other passenger amenities.

New runway and approach lighting systems were installed during 1948. Along the length of the main runway high-intensity contact lights were installed, and on the eastern approach is a "red vee" low-intensity system for use in normal conditions and the "line and bar" system (with a high-intensity centre line and seven cross-bars of sodiums) for use in foggy weather. Work on runway construction will continue during 1949 in accordance with plans made to enable London Airport to handle all Northolt's traffic when that airport is handed back to the R.A.F. in 1955.

The sightseers' enclosure, which was visited by 277,000 people last year, will reopen in time for Easter and will have an enlarged car park. During 1948 more than 4,000 people were employed on the Airport in addition to the contractors' workmen engaged in constructional work. Nearly 1,000 of the Airport employees are attached to the Ministry of Civil Aviation on air traffic control, briefing, meteorology, signals, radio and lighting maintenance.

AUSTRALIAN APPOINTMENT

THE Ministry of Civil Aviation and the Commonwealth Relations Office have announced the appointment of A.V.-M. R. P. Willock, C.B., as Civil Aviation Adviser to the United Kingdom High Commissioner in Australia. He is expected to take up his appointment in June.

A.V.-M. Willock served in the R.F.C. during the 1914-18 war and transferred to the R.A.F. in 1918. Educated at Marlborough, he is a graduate of the Army Staff College, Camberley, and of the Imperial Defence College, and during his Service career in the R.A.F. he was Air Attaché to His Majesty's Ambassador in China in 1933-36. He was appointed Director of Staff Duties, Air Ministry, 1938-40, and A.O.C. No. 21 Group and Commandant of the R.A.F. College, Cranwell, from 1940 to 1943. In 1946 he was appointed Civil Air Attaché in Washington and during 1947 acted as the representative of the Minister of Supply in connection with the negotiation of bilateral agreements for civil air services between the U.K. and foreign countries. During the same year he was a member of the U.K. delegations to the assemblies of the International Civil Aviation Organization at Montreal and Geneva.

TURNHOUSE REOPENS

TOMORROW, April 1st, Turnhouse is to be restored to use as Edinburgh's civil airport. The main runway is now ready for use, extensive consolidation having been carried out at its far end, and S.B.A. has been installed. The former R.A.F. buildings have been converted into passenger-handling accommodation, special emphasis having been placed on a cheerful, attractive scheme of decoration. Among the amenities are a lounge, restaurant, V.I.P. room, enquiries counter, and bookstall. Freight accommodation includes a bonded transit-store.

The morning southbound service from Renfrew will arrive at 0830 hr and leave at 0905, bringing passengers to the Kensington terminal at 1208. In the evening, the 1820 aircraft from Renfrew will arrive at 1850 and leave at 1923; its passengers are due in London at 2228. In the reverse direction, London terminal departures are at 0756 and 1830, arriving at Turnhouse at 1106 and 2140 respectively.

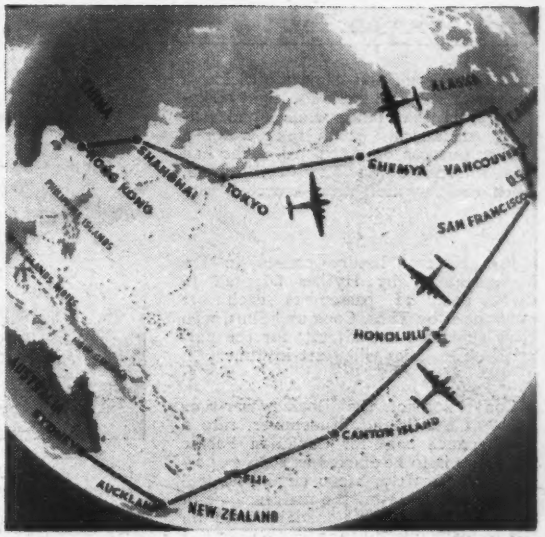
Cdr. G. A. Nunneley, O.B.E., R.N.—who was associated with Turnhouse at its inception as an airfield in the far-off days of 1915—will be in charge, assisted by Mr. W. S. Walker.

CANADIAN TRANS-PACIFIC ROUTES

THE accompanying map shows the routes that have been announced for Canadian Pacific Air Lines' two new trans-Pacific services which are to come into operation later this year. The southern route, to Australia, will be the longer—9,018 miles from Vancouver to Sydney by way of San Francisco, Hawaii, Canton Island, Fiji and Auckland, New Zealand. The northern route will measure 6,500 miles, from Vancouver to Hong Kong by way of Alaska, Shemya (Aleutians), Tokyo and Shanghai.

Refuelling will be carried out at each of the stopping points, while all overhauls and major maintenance work will be done at a big Canadian Pacific Air Lines base in Vancouver which, as mentioned on the next page, is now being planned. Turn-around inspections will be made at Sydney, for the northern route, and at Hong Kong for the southern route.

At the same time, there will be facilities at all points of call on both routes for repairs; complete supplies of spares, including entire engines and other units, will be available at all bases.



The new Canadian Pacific routes, referred to in an adjacent paragraph.

NEW AER LINGUS SERVICES

SUMMER services from Dublin to the Isle of Man will be restarted by Aer Lingus on May 1st with one flight each Friday, Saturday and Sunday. From July 1st the service will be increased to a daily service with extra flights at the week-ends in the peak holiday months of August and September. The new Dublin-Jersey service, operating one return trip each Sunday, will come into operation on June 5th.

On May 2nd Aer Lingus will start daily return flights between Dublin and Birmingham. The flight is scheduled to leave Dublin at 0925 hr, reaching Elmdon at 1050 and the return flight will leave Elmdon at 1120 and arrive in Dublin at 1255. The fare is £6 single and £10 16s return.

The weekly all-cargo service between Dublin and London which was resumed on March 3rd leaves Dublin on Thursdays at 0945 hr, arriving at Northolt at 1145. The return flight leaves Northolt at 1320 and reaches Dublin at 1520.

I.O.M. ACCIDENT FINDINGS

THAT pilots be again reminded that radio D.F. and homing aids are not necessarily situated on airfields (vide *Notice to Airmen* No. 290/48) is the recommendation concluding the report* of the Chief Inspector of Accidents into the crash which occurred in the Isle of Man on June 10th, 1948, to a de Havilland Rapide of Hargreaves Airways, Ltd. The aircraft flew into a hillside 1,219ft above sea-level, killing the pilot, Mr. C. S. M. Herbert, and five passengers, while two passengers were seriously injured.

A. Cdre. Vernon Brown finds that the accident "was the result of an error of navigation by the pilot in that he failed to maintain a safe height when approaching Ronaldsway V.H.F. homer from the west." That the pilot was unaware of the position of the homer, adds the report, was a possible contributory factor.

* *Price 9d, H.M. Stationery Office.*

K.L.M. INCREASES SERVICES

INCREASED services on routes to European cities and the Far East have been announced by K.L.M. and will come into operation on April 3rd. The existing 33 passenger services a week between London and Amsterdam, operated by Convairs, will be increased to 41, three of them terminating at Eindhoven. Two extra services each week will be flown to Switzerland and one extra to Italy, calling at Frankfurt and terminating at Milan, while one of the existing Rome services will fly via Nice instead of Marseilles.

Two extra services will go to Germany and the flying time to Munich will be reduced by an hour. Services to Athens and Tunis will be reduced by nearly three hours, and, by eliminating the night stop at Istanbul, the Amsterdam-Teheran service will be reduced from 37½ hours to nearly 20 hours. Twenty-eight services a week are scheduled on the Amsterdam-Brussels route.

INTERNATIONAL AIRLINE PILOTS' CONFERENCE

PILOTS' organizations of fifteen nations will be represented at the third conference of the International Federation of Air Line Pilots' Associations which is being held in Dublin from April 4th to 7th under the aegis of the Irish Air Line Pilots' Association. Previous conventions were held in London in April, 1948, and in Paris in September, 1948, and it is the intention that conferences shall be held annually.

An application for membership from the Air Carrier Pilots' Association of Sweden will be considered at the meeting and it is expected that a representative of the Finnish pilots will be present as an observer. Apart from this, the work of the conference will be primarily connected with technical matters concerning airline operation from the pilot's angle.

The president of the conference will be Mr. David Behncke (A.L.P.A.) and the secretary Mr. D. Fellows (B.A.L.P.A.). The B.A.L.P.A. delegation will consist of Capt. A. P. W. Cane (chairman), Capt. T. H. Farnsworth (vice-chairman), and Capt. F. Ormonroyd (technical representative).

BREVITIES

IT was recently reported from Moscow that a new air service has been opened between Moscow and Irkutsk in Eastern Siberia. A daily service is operated and the flight takes 26 hours. A train on the Trans-Siberian railway takes six days to cover the distance.

* * *

Commander Kenneth Kemble, commercial manager of International Aeradio, Ltd., recently left London on an official visit to Greece, Turkey and Israel. During the last 18 months he has travelled 160,000 miles visiting and advising on radio installations.

* * *

Mr. L. B. Elwin, A.F.C., one-time chief instructor at the Empire Flying School, has been appointed general manager of Westminster Airways, Ltd. Mr. J. H. Robertson has been appointed commercial manager and Capt. G. F. O. Mahony has become chief pilot.

* * *

Flying Cloud, the first Boeing Stratocruiser to be delivered to the Atlantic Division of Pan American Airways, arrived at La Guardia Airfield on March 21st. The delivery flight of 2,580 miles from the makers' works at Seattle took 8 hr 22 min. It is expected that the Stratocruiser will make its inaugural flight to Europe some time in April.

* * *

Bahamas Airways, an associate company of British South American Airways Corporation, has inaugurated a twice-weekly service with 21-seater amphibian aircraft linking West Palm Beach, Florida, with Nassau in the Bahamas. The service leaves Nassau on Tuesdays and Saturdays at 0930 hr, arriving at West Palm Beach at 1100 hr. The fares are $25 single and $45 return, valid for a year, with a special rate of $40 for a monthly return.

* * *

On March 23rd the Egyptian Government lifted its ban on night flying. The Civil Aviation Department announced

Civil Aviation News . . . . .

that the Farouk and Almaza airfields at Cairo would be available for night operations from that date, while Fuad Airport, Alexandria, would re-open for a similar purpose on April 3rd. The ban was introduced on May 15th, 1948, when the Egyptian army marched into Palestine.

* * *

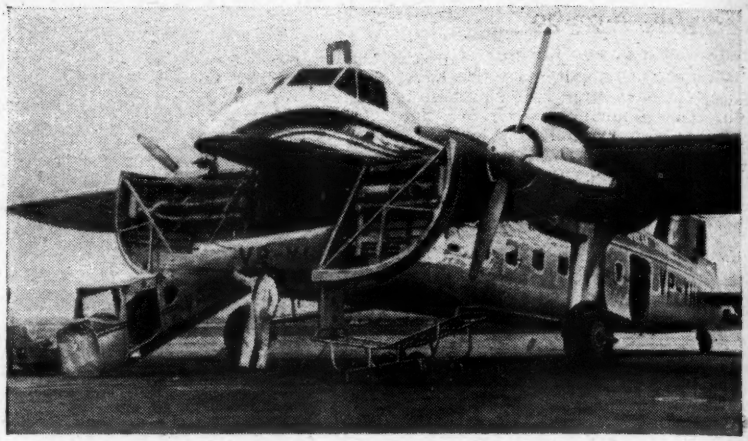
Fourteen-day luxury cruises in the Mediterranean by Hythes adapted to carry only 22 passengers each are announced by Thos. Cook and Sons, who have chartered the aircraft for the purpose. The series will start in June.

* * *

Conversion of the Boeing war-time plant at Sea Island, Vancouver, into a maintenance base for Canadian Pacific Air Lines is to be started as soon as possible. Ultimately, 1,000 employees will be engaged there on the maintenance of the company's four Canadairs used on the trans-Pacific runs, as well as aircraft used on the domestic routes.

* * *

In order to meet the usual substantial increase in air travel between London and Paris at Easter, B.E.A. have increased their services between the two capitals. Frequency is to be gradually stepped up until the peak day of April 14th, when 15 return services will be flown, an increase of eight. On Easter Monday there will be three extra services, making ten in all, and a total of eight on Tuesday, April 19th.



DOUBLE HELPING FOR A CANNIBAL: Bristol Freighter VP-YHW, flying a scheduled service for Central African Airways between Ndola, Northern Rhodesia, and the Rand, recently picked up the complete fuselages of two damaged Cessna aircraft and flew them 400 miles from Bulawayo to Palmietfontein, near Johannesburg. Also on board were 16 passengers, crew and a normal load of freight. Previous examples of cannibalism by the Freighter have been provided by an Anson, a Consul and a Tempest.

Pan American Airways' report for 1948 shows an estimated net income of $1,147,500 compared with $740,000 in 1947. Gross revenue amounted to $36,304,000 against $35,590,500 the previous year. These figures include passenger revenue of $21,616,250 for 1948 and $23,605,550 in 1947 when $2,212,500 from Panair do Brasil was included. Mail revenues in 1948 totalled $8,349,000 against $4,203,285 in 1947.

FROM THE CLUBS

AS many of the Club members and the majority of the staff are ex-A.T.A. personnel, the West London Aero Club at White Waltham will start its summer social activities with the A.T.A. Association annual general meeting and reunion on April 9th.

A series of flying competitions is being organized, leading up to the award of the Windmill Theatre Challenge Cup, which was presented by Mr. V. van Damm last year. Social events, including dances and film shows, are being arranged through the summer and the dates will be announced later. Recently four members obtained their "A" licences. During February 92 flying hours were logged and for the first three weeks of March a total of 96 was recorded.

* * *

HIS many old friends and pupils will be interested to learn that Mr. Cecil Pashley, M.B.E., chief instructor of the South Coast Flying Club, has been appointed manager. He has been actively engaged in aviation since the pioneer days when, with his brother, he opened a flying school at Shoreham.

After the first world war, in partnership with F. G. Miles, he started the Southern Aero Club, which ran successfully until 1935, when it was taken over by the Brooklands group of clubs and became the South Coast Flying Club, Mr. Pashley retaining his position as C.F.I. The Club trained a large number of pilots, both as members and in the Civil Air Guard.

In July, 1946, a fresh start was made at Shoreham in comfortable and spacious premises, and the officials hope that any old friends and members who are within reach will pay the Club a visit, when they will be given a most cordial welcome.

* * *

STRENGTH of the London Transport (Central Buses) Flying Club now stands at 1,200 members, of which more than 200 are actively flying. The Club operates at Fair Oaks (with three Tiger Moths, painted bright red), and despite the fact that last year's operations showed a loss of more than £1,000, drawn from capital, the flying charges remain at 15s per hour; the operational cost is actually more than £3 per hour. It is a comment on present-day conditions that before the war the Club was able to pay its way by charging 8s an hour for ordinary members and 3s for Civil Air Guard pilots, apart from the modest sixpence-per-week subscription paid by all members.

Mr. E. Baker learned to fly with the Club before the war, served in the R.A.F. as an instructor, and returned to the Club as its C.F.I. Another enthusiast, Mr. J. Mars, served as aircrew during the war and then obtained his "A" licence through the Club. He has now enlisted in the Reserve as a pilot.

* * *

FEBRUARY'S unusually good weather brought out many members of the West Riding Aviation Centre and in the hangars there was a quickening of activity as Rapides, Proctors and Austers passed out for C. of A. During the month five new flying members and six new ground members joined, bringing the total membership up to 442.

The West Riding Centre was recently mentioned by the Association of British Aero Clubs and Centres as an example of the best type of body combining in one organization the interests both of amateur flying enthusiasts and of those attracted by the purely social aspects of civil aviation.

* * *

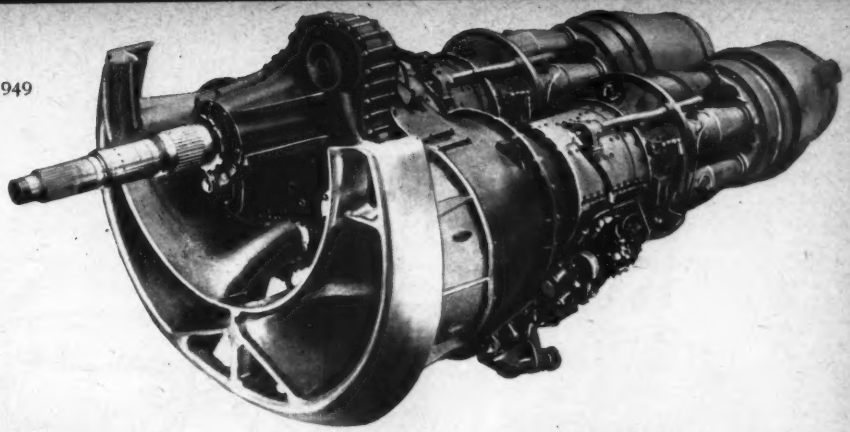
AFTER lengthy negotiations between the Luton Corporation and Hunting Flying Clubs, Ltd., on the future of the Luton Flying Club, it has now been decided that the Club shall continue in existence, although the two interests concerned have not yet agreed on a renewal of the lease. The Club has notified all its members that its activities will continue and is once again in a position to accept new members.

At the end of 1948 there were 250 members and the aircraft consist of an Auster, a Magister and a Proctor. Despite the Club's uncertain position, 47 flying hours were logged in January and 40 in February. A "chairborne" meeting has been arranged to take place in the clubhouse on Saturday, April 2nd; on this occasion the members will discuss the flying and social events for the coming season.

* * *

THE Midland Aero Club, in conjunction with the Royal Air Force Association, is to hold an air display at Elmdon Airport, Birmingham, on Saturday, June 25th. The event will be open to the public and it is believed that at least 10,000 people will be present. Proceeds will be given to the R.A.F. Association's Funds.

In addition to the normal flying programme with civil, R.A.F. and Naval aircraft, there will be a race in which five Midland Clubs will compete, each with a team of three aircraft. The winning team will be awarded the Midland Inter-Club Challenge Trophy and cash prizes and the winning pilot will receive the Midland Aero Club Challenge Trophy. Full catering arrangements will be provided as well as licensed bars and accommodation for up to 2,000 cars.



DOUBLE MAMBA

"Siamese Twin" Turboprops with Coaxial Drive: A Two-engine Installation with Single-engine Implications

IT was just about a year ago—in fact, on March 18th, 1948—that *Flight* published a full description of the Armstrong Siddeley Mamba turboprop. Since then the name Mamba has appeared at fairly frequent intervals in these pages, although chiefly in conjunction with aircraft names such as Apollo, Balliol and Athena. Now, however, it occurs again, so to speak, in its own right—and at double strength, too.

The idea of installing two engines as a single power unit is by no means new: various schemes were tried in the very early days, most of them attended with indifferent success; then, in the pre-war decade, Macchi-Castoldi used coupled Fiat engines in their racing seaplane; Lockheed installed a pair of Menascos as the Unitwin in the nose of the Vega Starliner; and during the war the Germans produced the Heinkel 177 with a pair of coupled DB 605s. More recently we have examples of double-engine installations in the Brabazon I prototype, and coupled-engine layouts in the Proteus-engined second prototype Brabazon and the Saunders-Roe SR 45 boat.

Terminological Exactitude

Perhaps before going farther, it is desirable to review the drive situation and terminology in relation to "single-twin" installations. Briefly, the paired engines can be coupled together so that they jointly drive an airscrew which, to-day, is usually of contra-rotating type, or each engine can give drive to its own individual airscrew. In the latter case, current practice is to mount the airscrews in tandem on coaxial shafts, each rotating in the opposite direction. It should be emphasized that, although the external appearance might be precisely similar, the first-mentioned power installation employs two engines to drive a common airscrew, whereas the other embodies each engine driving a single airscrew. To differentiate between the two systems, the first (with coupled engines) is said to employ a contra-rotating airscrew, whilst the second (with double engines) is said to use coaxial airscrews. It is, of course, contra-rotation which is confusing, but it may simplify matters to realize that in the first system an ordinary airscrew with a single bank of blades could be used instead of a contra-prop, providing, of course, that it was sufficiently large to provide the requisite blade area. The second system, however, necessarily involves the use of two separate airscrews: it is simply more convenient to mount them close one behind the other and rotate them in opposite directions. This is the system for which Armstrong Siddeleys have devised the Double Mamba power installation.

The Mamba used for the double installation has been increased in power from the 1,010 s.h.p. of the A.S.M. 1 of our original description, up to 1,270 s.h.p., and the residual jet thrust has gone up from 307 lb to 384 lb. Although the compression ratio remains the same at 5: 1, the fact that the maximum r.p.m. have been increased from 14,500 to 15,000, together with modification of the compressor blading, has resulted in the mass flow being increased from 13.5 lb/sec up to 17 lb/sec, and the outlet velocity comparably increased from 310 up to 403 ft/sec.

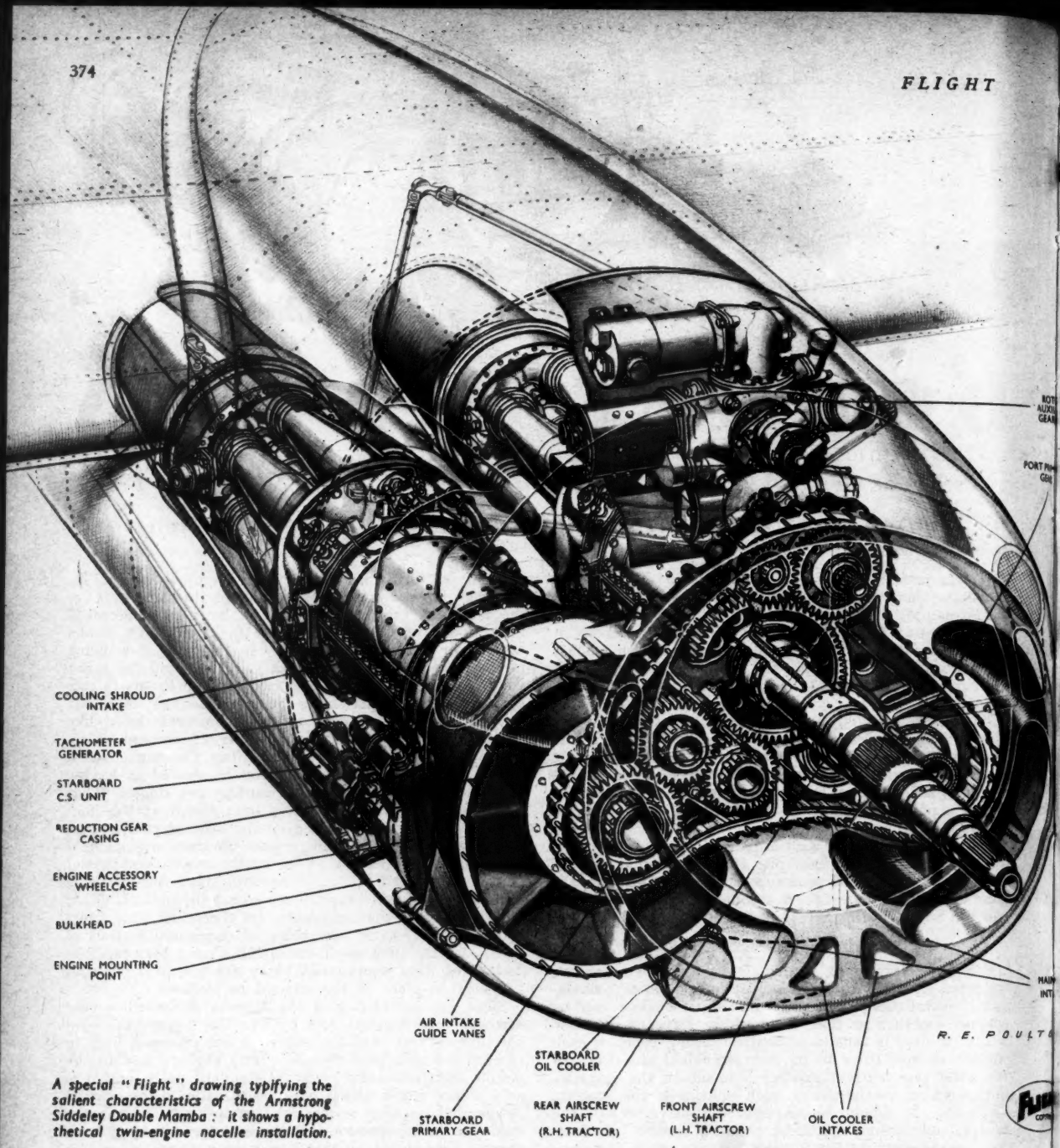
The 26 per cent increase in the mass flow has occasioned increase of the inlet area to the compressor by a like amount. This has resulted in a certain amount of re-design of the compressor. Regarding the original as a datum, the present compressor can be viewed as having been shifted proportionately forward by two stages. That is to say, two new stages have been added at the inlet end, of a depth extrapolated on the original passage-profile curve, and at the outlet end the two original final stages have been deleted. Whereas the original compressor passage converged up to the seventh stage, thence being parallel, the present shape is convergent throughout. Other modifications to the compressor are concerned with structure, the inner shaft now being of duralumin instead of steel, and the inlet guide-vanes HR Crown Max castings instead of RR-57 stampings: they are also of 7 per cent t/c ratio in place of the original 10 per cent.

Since the description of the Mamba published a year ago was very detailed, and by now the "geography" of the unit is very well known, it is not proposed here to recount the structural details. Both engines used in the double installation are perfectly standard units, and it is only where modifications have been made to the original design that we shall review the description. The changes made to the compressor and the increase in ratings have already been noted, so that now we can go on to consider the reduction gear and airscrew drive.

Transmission Design

In basic design, the reduction gear of the Mamba itself remains unchanged, although sundry detail modifications have been embodied. The compressor drum is flange-bolted to a drive-transfer member, the bore of which is fashioned with six semi-circular-section splines through which torque is given to a forward-extending torsion shaft. At its forward end, the latter is serrated to a sleeve which is, in turn, serrated to the bore of a sun-gear. The sleeve coupling is resorted to in order that the compressor (or, for that matter, the whole of the power-producing part of the engine) may be changed without disturbing the reduction gear. Incidentally, the forward mouth of the sun-gear is buttress-dogged for engagement with the starter coupling shaft.

The sun-gear has 27 helical teeth and meshes with three 38-tooth planet pinions. These are integrally fashioned



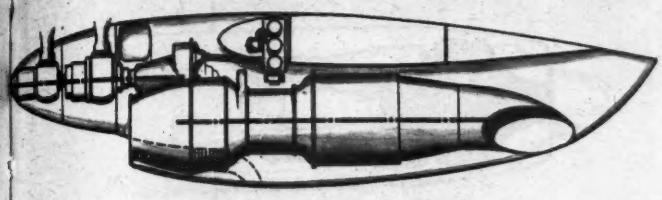
A special "Flight" drawing typifying the salient characteristics of the Armstrong Siddeley Double Mamba: it shows a hypothetical twin-engine nacelle installation.

DOUBLE MAMBA . . .

coaxially with spur-type satellite pinions, each of 15 teeth, which react against an internal annulus gear of 63 teeth. As in the original Mamba, the internally toothed annulus is a "floating" member through which torque is measured, but, whereas the original torquemeter employed eight balancing pistons, the current type uses only three. The floating annulus has a "spine" flange which registers in three channel-segments bolted to the gearbox and so affording axial location of the gear; steps in the channel segments mate with steps in the spine flange to provide reverse torque stops. Radially, the annulus is located concentrically by its meshing with the three satellite pinions.

Projecting forward off the spine flange are three buttressed forks in which register ball/socket-ended fingers, each forming an arm of a bell crank, the other arm of which bears against a ball-ended compression strut transferring thrust to a piston. In this way, torque in the annulus is converted to linear motion of each of the three torquemeter pistons. This movement is resisted by hydraulic pressure in each balancer cylinder, all three units being supplied from a single constant-delivery gear-type pump. The oil pressure in the cylinder varies according to the torque, and is indicated in the cockpit by a gauge.

The carrier for the planet and satellite pinions is fashioned with a shaft which, in the ordinary single Mamba, is the airscrew shaft; in the double Mamba installation, however, it must be considered as the output drive shaft, in that it carries and gives torque to the primary spur gear of the airscrew driving train. At this point, perhaps, it should be mentioned that in the double Mamba the airscrew reduction is divided into two stages: the epi-



Section through twin-engine nacelle, showing relationship of engines and airscrews to the wing.

cyclic gear gives a reduction ratio of 0.1447 : 1, and in the second stage (spur) train the reduction is brought down to 0.0964 : 1.

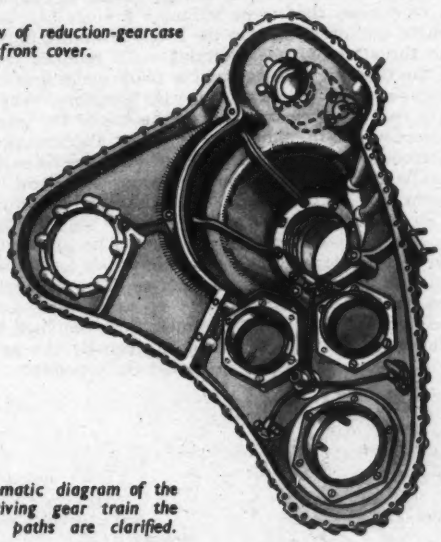
From this point we must, for the moment at least, consider the drive assembly as a whole. Each Mamba gives its drive into a common secondary reduction gear which, however, exists solely in order to provide coaxial airscrew-shafting and contra-rotation. The port-engine primary gear engages an idler gear of similar diameter which, in turn, engages the 60-tooth airscrew-driving gear splined to the inner airscrew shaft, i.e., for the front airscrew. The starboard-engine primary gear transmits through two 32-tooth idler pinions to the foremost airscrew driving gear which, on the outer airscrew shaft, serves the rear airscrew. In this manner, the left-hand rotation of the engines is maintained for the front airscrew and reversed for the rear airscrew.

All the spur gears of both driving trains run in roller bearings carried in the two internal diaphragms of the gearcase. Both airscrew-shaft gears are, however, cone-seated at the front and roller-bearing-supported at the rear, with hub-splines to the shafts: the bearing for the front gear serves also as a tail support bearing for the shaft. The tail bearing of the inner shaft is of deep-groove ball type, and takes the whole of the front-airscrew thrust load. In the nose of the gearbox casing is a ball- and roller-bearing assembly, the ball bearing taking the rear-airscrew thrust, whilst the roller bearing takes the outer shaft journal loads.

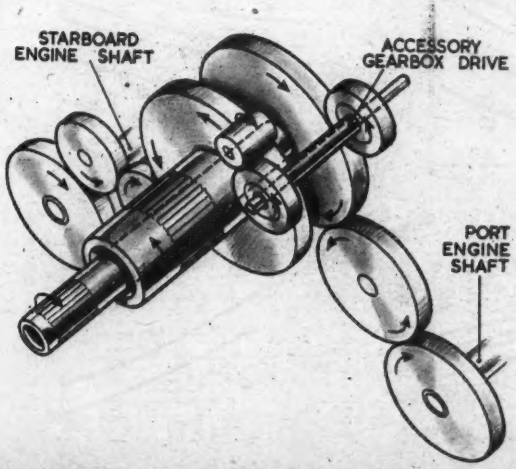
Pitch-change actuating oil is given to the front airscrew by the normal coaxial tube arrangement, but for the rear airscrew a twin-cavity sleeve is nested between the inner and outer airscrew shafts, coarse-pitch oil being fed through one cavity and fine-pitch oil through the other.

The gearbox itself is made up of a rear casing carrying the epicyclic gears and embodying the kidney/annulus air-inlet tracts; a centre casing carrying the spur trains; and a front cover incorporating the nose extension housing the airscrew shafts. These casings are all cast in magnesium alloy to Specification D.T.D. 281. Slightly offset to port of the vertical centre-line plane through the airscrew shafts at the head of the gearcase is the take-off drive to the Rotol accessory gearbox mounted on the bulkhead.

Interior view of reduction-gearcase front cover.



In this schematic diagram of the airscrew driving gear train the transmission paths are clarified.



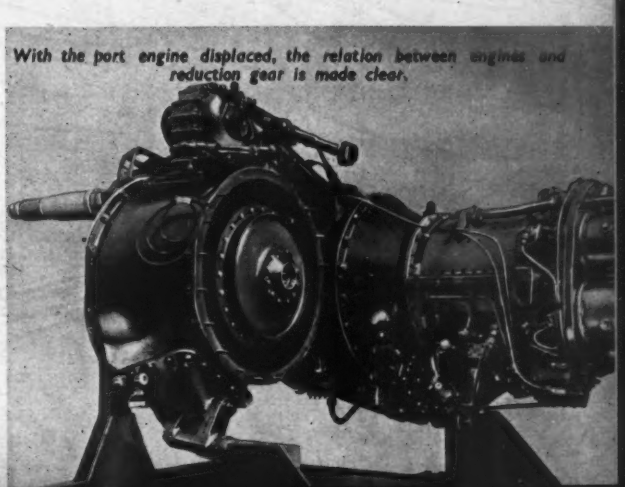
Accessory Drives

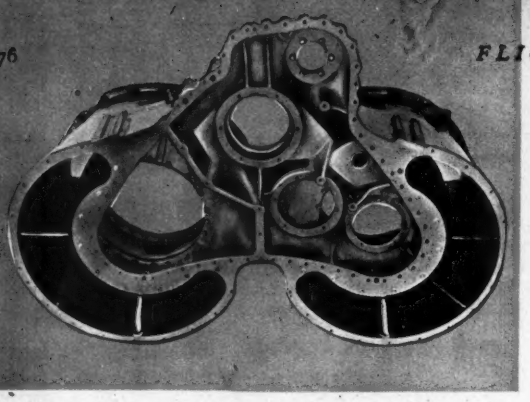
In that this unit must be driven, no matter which engine is dead, twin-drive is embodied in the form of double wedging-roller freewheel assemblies. A small gear meshing with the rearward gear of the airscrew drive runs on twin roller bearings flanking a central wedging-roller unit, the inner race of which is serrated to a quill sleeve. Forward of this train is a similar assembly which, however, is driven through an idler off the foremost airscrew gear to cater for handed rotation. The quill sleeve is serrated at its front end to the hub of a bonded rubber/metal flexible driving member, through which torque is given to a quill shaft running coaxially back within the sleeve to the Rotol gearbox, the final drive element being through the usual universal joint. The reason for this form of drive is that, by the use of a long shaft, the angularity of any misalignment is reduced and the unsatisfactory business of having two universals close together is eliminated.

Whereas in the original Mamba the engine-mounted auxiliaries were driven from a spur gear keyed on the rear of the planet carrier, this scheme no longer applies. One of the reasons for the change is that the various auxiliaries are now mounted beneath the engine instead of at the top and, too, the number has been reduced.

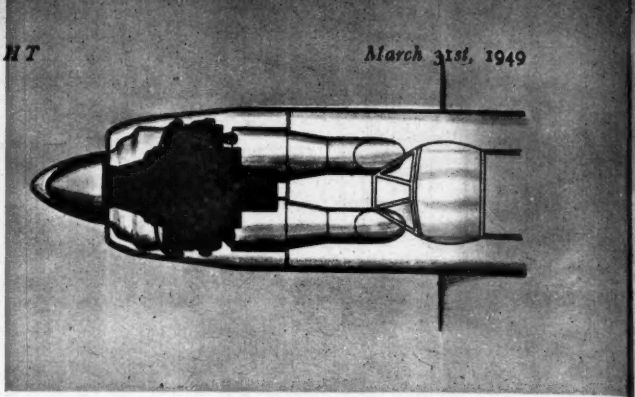
In the present system the drive is taken by means of a pinion keyed on the drive transfer member between compressor drum and torsion bar. This pinion meshes with a spur wheel dowelled to a bevel pinion which transfers drive to a vertically dependent shaft with a further bevel at the heel. This last meshes with an integral bevel-spur pinion on the base centre-line of the engine in the centre of a U-form wheelcase. Drive to port is given, via an idler, to the oil scavenge pump (forward) and pressure pump (aft): outboard of the pumps is the pressure filter mounted on the end face of the wheelcase. At the rear of the wheelcase the fuel pump is located on the centre-

With the port engine displaced, the relation between engines and reduction gear is made clear.





Forward view of main gearcase casting, showing details of structure.



Comparative diagram showing Double Mamba installation in a single-seat naval aircraft normally powered with a Centaurus engine.

DOUBLE MAMBA . . .

line and is shaft-driven direct from the bevel-spur primary pinion. To starboard an idler transfers drive to a spur pinion, hub-serrated to the c.s.u. shaft (the c.s.u. being mounted on the rear face of the wheelcase) and meshing outboard with a pinion on the tachometer-generator shaft. Drive is also given from the spur pinion to the ignition switch governor and torque reverse switch circuit energizer. This little unit is simply a centrifugal governor which, when the engine has attained sufficient r.p.m., cuts out the torch igniters and simultaneously cuts in the torque reverse switch circuit.

To go back now to the output drive shaft of each Mamba, it has been stated that the forward mouth of the sun-gear is dogged for engagement with the starter shaft. The latter is housed coaxially within the output drive shaft and, at its forward end, is internally splined for engagement with a transfer coupling in the starter drive. There are spaces between the coupling and shaft splines such as to allow 30 deg of differential angular movement between the two. The end of the shaft is further fashioned with helical ways which mesh with helical keys on the transfer coupling. Thus, when the starter rotates the coupling, the helical "threads" move the shaft rearwards to engage the dogs on the sun-gear, and, subsequently, the four wide-spaced splines, the design being such that torque is not transmitted through the splines until the dog coupling is fully meshed.

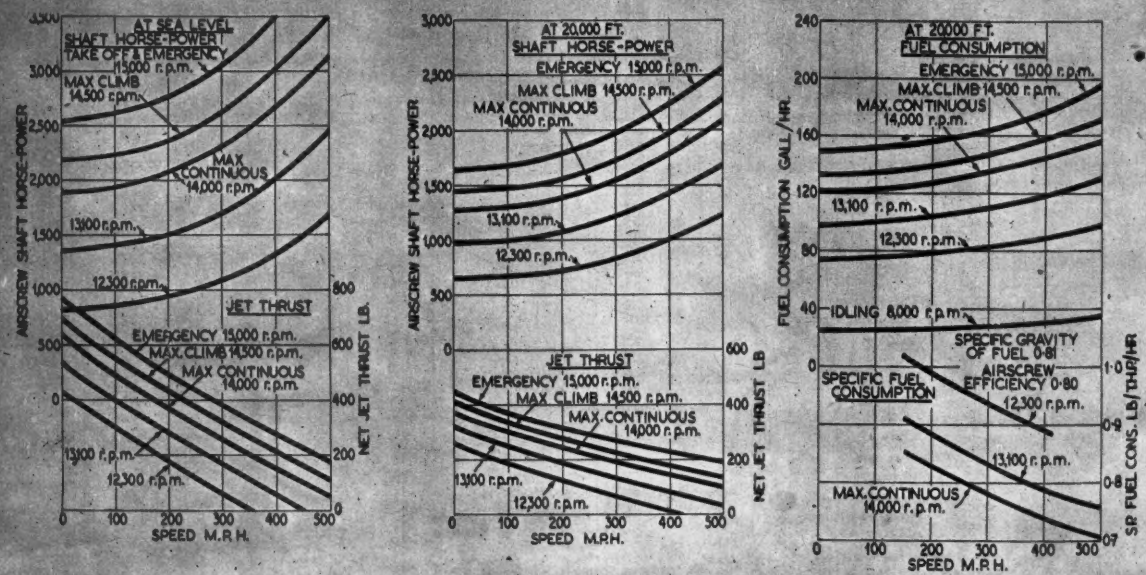
The transfer coupling is a spur wheel (carrying the helical keys and spaced splines on its shaft) which takes drive from a pinion hub-serrated to the starter shaft. The step-down gear ratio is for 10,000 starter revs to give 4,000 engine revs. Both B.T.H. and Rotax turbo-starters are specified (each of which, with a cordite charge, will give a start in 2½ sec), or, alternatively, an electric starter could be used, the mounting face provided on the Mamba being of standard S.B.A.C. pattern.

It is rather interesting that, although a starter is fitted to each engine and the design requirement is for individual starting, running trials on the Armstrong Siddeley test beds at Anstey have demonstrated quite conclusively that one engine can be started from the other. It apparently does not matter whether the second engine to be started is the port or starboard unit. If, for example, the starboard engine has been started, the airflow through the front airscrew induced by rotation of the rear airscrew is quite enough to rotate the port engine up to r.p.m. sufficiently high to permit it to be started.

The great attraction of using doubled or coupled engines is, of course, that some valuable savings can be made in weight and drag, and, in the event of failure in one engine, the thrust unbalance is acting on a reduced lever arm—in the case of, for example, a two-nacelle four-engine aircraft—and the offset moment is, therefore, very considerably reduced. Not only does this make the pilot's job of corrective action much simpler, but it also means that those enormous fin and rudder areas which have recently become familiar can be cut down a good deal, and this itself means still further reductions of drag and structure weight.

To this the natural query is, why has the method not become common practice before? The answer is that it would have done so had the bulk-power and power-weight ratios of available engines been such as to permit duplex installations without sacrifice of more than would have been gained. It is the slimness and the high output in relation to low weight which is given by the axial turbo-prop which makes the "single-twin" possible now—and

Power and consumption curves for the Double Mamba at sea level and at 20,000ft.



Double Mamba . . . . .

not only possible, but an actively attractive proposition.

Furthermore, although we have considered only the multi-engined aircraft, the system has obvious applications in the "single-engine" field. For example, a Double Mamba power installation in a naval or deck-landing aircraft would make available the high power required for take-off whilst, at the other end of the scale, it would give excellent endurance by allowing one engine to be cut out and the other used for cruising at reduced power. It would give better endurance, in fact, than could probably be obtained by operating at minimum ratings the conventional single-engine of sufficient maximum power to satisfy the take-off condition.

There is no doubt that, having a power installation split into halves in this manner permits the scope of operational flexibility to be widened very considerably indeed. To revert to our consideration of a two-nacelle four-engined airliner, and relate it to the just-mentioned long-endurance cruising condition; if, for example, our hypothetical commercial aircraft had to stand-off for any reason at its destination airport, the pilot could well cut out one engine, both port and starboard, and orbit on the remaining singles for a much longer period than would otherwise be possible. And the important aspect of this (and, of course, it applies equally to the "single-twin" naval type) is that it would involve no difficult trim compensations or unpleasant changes in control characteristics.

There are no untoward penalties to be paid for the Double Mamba power installation on maintenance or accessibility grounds: it could, on the contrary, well be argued that the layout offered positive advantages in this regard. On the score of drag debited to power installation, the double engine system holds the balance of credit by a comfortable—and valuable—margin. The advantages accruing from the shortened span of the thrust axes in relation to control in asymmetric flight have already been touched upon. There remains the question of weight. Briefly, the weight entailed by the airscrew driving-gear trains is a quantity which does not have to be borne by separate single-engine installations. However, it can be demonstrated that this weight penalty can virtually be balanced by the redundance of a number of ancillary items, such as bulkheads, cowls, separate controls, oil coolers, tankage and fixtures, and by savings in airframe structure-weight, so leaving a credit balance of advantage resulting from control simplicity and reduction in drag.

C. B. B.-W.

DART TYPE-TESTED AT 1,250 S.H.P.

(*continued from page 363*)

of a Derwent running at high speed—it seems that, if anything, there was a slight improvement in running due to the effect on combustion of the steam generated.

Opinion seems to be held fairly generally that icing will not, in fact, constitute a problem with the Dart. The danger-point for ice formation would be the intake annulus itself. Further back the combined reduction gear and intake casing, and the oil tank cast integrally with it, would be hot enough to prevent ice formation. On top of the oil tank, and within the overall diameter of the engine cowling, is mounted a small oil-cooler. Air for this cooler is aspirated through a second annulus outside the main engine-air intake, and the nose ring of the cowling into which the air passes forms a plenum chamber from which the oil-cooler is fed. The outlet is through a small gill on top of the cowling.

From the operator's point of view the Dart has already shown itself to have a number of very desirable features. The time for a complete engine change with airscrew fitted is as little as 45 minutes, and on one recent occasion a Dart was installed and connected up in the Viscount in 13 minutes. The units are not particularly sensitive to jet-pipe length or angle, and 20 deg deflection, or even more, would be quite acceptable without appreciable loss of performance.

For the present, the overhaul period is provisionally fixed at 200 hours, but this figure is likely to be increased substantially as experience is gained with the units. The Dart-Wellington is at present being used at Hucknall to check actual performance and power developed against estimated performance. The Viscount has already completed well over 100 hours' flying and it is hoped that before long it will be able to pay a visit to America, where it is certain to arouse the greatest interest.

ROLLS-ROYCE DART DATA

Two-Stage Centrifugal Compressor, Two-Stage Turbine

Mass air flow at max. r.p.m.	18 lb/sec.
Compression ratio	5.5 : 1
Overall diameter	38.5 in
Length to exhaust cone	94.75 in
Frontal area	8.10 sq ft
Weight without airscrew	850 lb
Weight/power ratio	0.56 lb/h.p.

R.Da.3 Power Rating

Rating	r.p.m.	Aircraft Speed (m.p.h.)	s.h.p.	Fuel Consumpt. (lb/hr)	Thrust lb
Max take-off and combat	14,500	0	1,400	1,080	295
Theoretical, fuel flow unrestricted		100	1,420	1,085	215
		200	1,475	1,100	140
		300	1,570	1,130	70
		400	1,715	1,180	0
Max continuous cruising	14,000	0	1,120	920	250
		100	1,150	925	175
		200	1,205	945	105
		300	1,300	970	35
		400	1,435	1,005	-35
Normal idling	6,000	0	45	—	—
Approach idling	6,000	150	60	—	—

FORTHCOMING EVENTS

Mar. 31st.—Royal Aeronautical Society: "Repeated Loading of Aircraft Structures," Dr. P. B. Walker, M.A., F.R.Ae.S.

Mar. 31st.—R.F.C. and R.N.A.S. Reunion, Londonderry House, W.1.

April 2nd.—British Interplanetary Society: "Astronautics and Astronomy," M. W. Ovenden, B.Sc., F.R.A.S.

April 4th.—R.Ae.S. (Derby): "Rocket Propulsion and Interplanetary Flight," A. V. Cleaver, A.R.Ae.S.

April 5th.—R.Ae.S. (Belfast): Evening of films by William Courtenay M.M.

April 6th.—R.Ae.S. (Weybridge): "Historical Review of Aircraft Development," Sir Frederick Handley Page, C.B.E., F.R.Ae.S.

April 6th.—R.Ae.S. (Luton): Film Show.

April 6th.—R.Ae.S. (Graduates' and Students' Section): "The Trend of Jet Engine Development," A. A. Lombard, A.F.R.Ae.S.

April 7th.—Guild of Air Pilots and Air Navigators of the British Empire: Annual Dinner, Londonderry House.

April 7th.—Royal Aeronautical Society: "Investigation of Aircraft Accidents in Relation to Aircraft Design," A. Cdre. Vernon Brown, C.B., O.B.E. M.A., A.F.R.Ae.S.

April 8th.—The de Havilland Aeronautical Technical School: 21st Anniversary Ball, Hyde Park Hotel.

April 12th.—R.Ae.S. (Belfast): Annual General Meeting.

April 13th.—R.Ae.S. (Leicester): Annual General Meeting and Members' Papers.

April 13th.—R.Ae.S. (Brough): "Brabazon Aircraft," F. H. Pollicut.

April 15th.—Institute of Navigation: "The Influence of Echo Sounding," A. J. Hughes, O.B.E.

April 18th.—Liverpool Chamber of Commerce: Air Display, Speke.

April 18th.—United Services Flying Club: Air Display at Elstree in aid Soldiers, Sailors and Airmen's Families Association.

April 19th.—R.Ae.S. (Graduates' and Students' Section): "The Meaning and Measurement of Stability Derivatives," P. Fink, B.E.T.

April 21st.—Royal Aeronautical Society: "High Lift Devices and their Use," R. R. Duddy, A.F.R.Ae.S.

April 21st.—R.Ae.S. (Gloucester and Cheltenham): Annual General Meeting. Followed by film "Atomic Physics," at Gloucester.

April 26th to 28th.—R.A.F. Golfing Society: Spring Meeting at Berkshire Golf Club, Ascot.

April 27th.—R.Ae.S. (Weybridge): "Present Day Problems in Safety Requirements," W. Tye, O.B.E., B.Sc., F.R.Ae.S.

April 28th.—Royal Aeronautical Society: The 37th. Wilbur Wright Lecture. "The Aeronautical Research Scene—Goals, Methods and Accomplishments," Dr. Hugh Dryden, F.R.Ae.S.

April 28th.—R.Ae.S. (Coventry): Annual General Meeting and film.

April 28th.—R.Ae.S. (Manchester): "Rocket Propulsion and Interplanetary Flight," A. V. Cleaver, A.R.Ae.S.

April 29th. to May 15th.—Paris Aero Salon.

April 30th.—No. 613 (City of Manchester) Squadron and A. V. Roe Ltd.: Air Display at Woodford airfield.

AMPHIBIANA

Powered by two 345 h.p. de Havilland Gipsy Queen engines : the Short Sealand taking off.

Some Reminiscences of Wheels-and-Water Aircraft, and a Plea for Their Development

By ALLAN F. VOAK

BRITAIN'S first amphibian aircraft was a little machine called the Batboat, built by Sopwith, and first flown by the late Harry Hawker in 1913. One can imagine the enthusiasm which must have greeted this new idea, and the plans which must have been laid for its development.

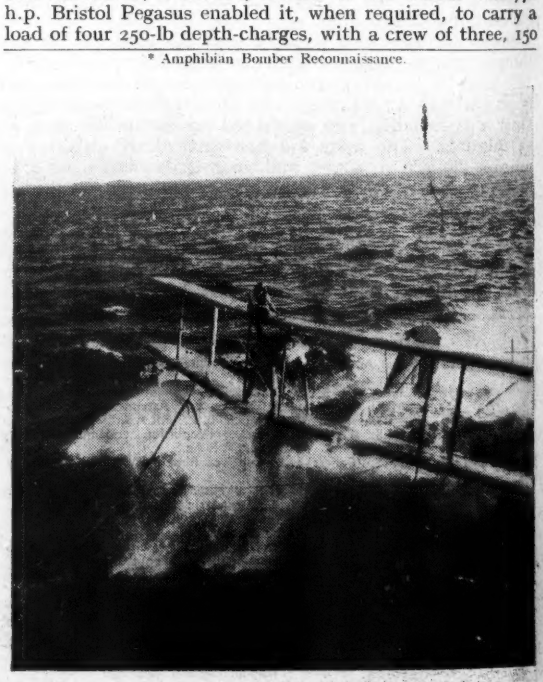
Yet, with all their apparent advantages, such dual-purpose aircraft have never achieved the popularity expected. The landplane has completely dominated contemporary aviation, so that marine aircraft, including their amphibious relation, have, comparatively speaking, occupied an "also-ran" position (as will emerge later, the future picture is somewhat different). This fact is all the more remarkable when it is remembered that the earth's surface is nearly four-fifths water, and that the very islands on which we live have a thousand natural and man-made harbours. Nevertheless, amphibians are still a comparative rarity, not only in this country, but almost everywhere else except America.

Historically, it may be said briefly that in Britain two or three firms have carried on the development of the amphibian, but normally only for military purposes, and often as a kind of side-line; the reason has lain not with the firms, but with the lack of a sizeable market. In the early nineteen-twenties Vickers produced the Viking amphibian, and the Supermarine Company the Seal and Sea King; in the years that followed, the merged firms were responsible for the development of the original Seagull, the Walrus, and then the present-day Sea Otter, and now comes the new monoplane Seagull. In the early 'thirties Saunders-Roe launched the Cutty Sark and Cloud. Short Brothers have produced occasional amphibians, but the new Sealand is their first new design in this class for seventeen years. In America Grumman lead the field, and have maintained a steady flow of military and civil amphibians for many years; fair numbers were purchased by the U.S. Navy for training and communications, and there has also been a moderate private-buyers' market.

Most of the amphibians produced in this country have been built for the Royal Navy, and it is in that Service that the author gained his knowledge of them; in this article he will recall some of his experiences during that period and attempt to relate them to the contrasting conditions of commercial operation.

The Supermarine Walrus was the sole British A.B.R.* type used up to the end of 1943, and the versatility of this aircraft is, I believe, known to the world. Its 770 h.p. Bristol Pegasus enabled it, when required, to carry a load of four 250-lb depth-charges, with a crew of three, 150

* Amphibian Bomber Reconnaissance.



A Walrus being picked up by a ship's crane in the Straits of Gibraltar.

gallons of petrol, full marine equipment and two Vickers K guns with ammunition. Alternatively, in the desert these old three-four-seater "shagbats" oft-times carried as many as ten long-week-ending "branch types" down to Alexandria; rumour speaks of even greater numbers. Opponents of the amphibian usually point out that it loses heavily in payload when compared with a corresponding landplane. Though, by the nature of its design, it *is* a less efficient load-carrier, the foregoing reminiscence suggests that the discrepancy can be kept very small, especially over short ranges

During anti-submarine operations in the Orkney area, the value of the dual-purpose Walrus repeatedly showed itself. Naval officers, civil engineers and Army personnel often had to be flown to little islands where not even the faithful Dominies could get down. The usual system was to fly around until a boatman (with boat) was discovered, then alight on the nearest suitable water. Passengers were transferred without the aircraft having to anchor. The snag arose only when the passengers desired to be taken home again on the same trip; the nature of the sea bottom was often such that the anchor, now desirable, would not hold, so the engine had to be kept running. An occasional flip round the island passed the time and kept the engine cleared. Incidentally, an incredible quantity of seaweed used to come up with the anchor chain, and it was a very messy and muscle-cracking job to haul it all inboard. Great fish could also be seen in the depths, and later they became such a nuisance as "suspected U-boats" that the C.-in-C. Home Fleet ordered any seen surfaced to be destroyed. The author recalls his observer and air gunner firing 1,000 rounds at one of these monsters, but without apparent effect. However, by chance, an unfortunate duck, flying at 300ft, was hit by a stray bullet and spun straight down into the sea, close to the shark (for that was what the monster was), which promptly swallowed it and died shortly after—probably from lead poisoning.

Three pilots of the Mandapam-Colombo Sea Otter service. Left to right, Lt. (A) Shearby, R.N.V.R., the author and Lt. (A) J. Beith, R.N.V.R.

Another advantage of the amphibian in the foggy Orkneys was its ability to take the air in practically any weather, with negligible radio aids, yet without undue risk. The Walrus carried a small "G.P." set, which, although satisfactory for ship-to-aircraft communication at short ranges, was practically useless as a homing aid. The Northern Isles, traditionally the haunt of elves and fairies, have (unfortunately for airmen) inherited their chief characteristic—the art of disappearing. It is not uncommon for the Orkneys to vanish suddenly in a large puff of ten-tenths sea fog and to stay that way for a day or two.

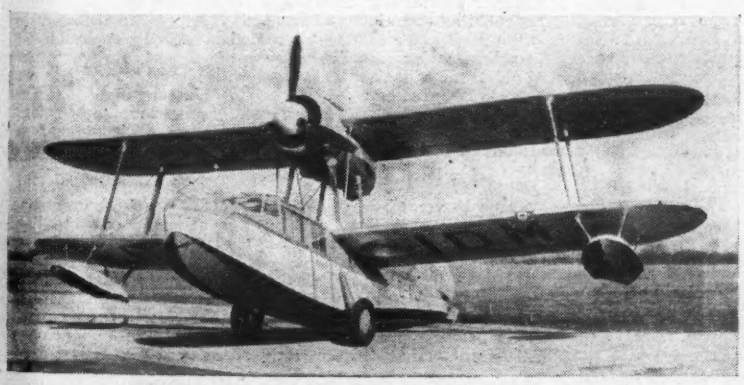
The reader will appreciate the good fortune of the "Walrus Boys," who, caught out by such an emergency, could, as a last resort, fly seawards, alight, and navigate home in true naval fashion. A large brass fog-bell was provided for these eventualities. On one occasion, a returning dusk-patroller managed to get down in the little fishing harbour of Stromness. Having made fast, the crew spent the night being wined in the local hotel. Unfortunately, next morning no Walrus was to be seen—only a mooring cable going (ominously) straight down into the depths. There is now a local legend that, on quiet evenings, when the current runs strong, strange "yanging" noises can be heard from far below, accompanied by dimly seen flashes and the distant tolling of a bell. It should be added that this information was obtained from a *most* unreliable source.

Seriously, however, it is a noteworthy fact that in several years of continuous wartime operation not one Orkney-based Walrus was lost through atmospheric conditions.

Hot Work

As another example of successful wartime amphibian operation mention may be made of the "Royal Naval Sea Otter Service Colombo - Mandapam." Some such title as this described the thrice-weekly scheduled service, for V.I.P.s only, from Colombo to the Combined Operations base of Mandapam—a place situated on a tongue of sand near Adam's Bridge, in Southern India. After take-off from the R.N. Air Station at Colombo the flight was almost entirely over water, and of about 2¼ hours' duration. The landing was made on the open sea, close inshore, and, after mooring, passengers and crew were disembarked by native boats. The return flight was made in the afternoon. This trip saved the fortunate V.I.P. no fewer than five days of travelling by rail, road and sea. There was no airfield within any reasonable distance of Mandapam, and the amphibian presented the ideal solution to such a transport problem.

Only one difficulty was encountered on these flights, and it was entirely due to the Sea Otter's archaic starting device. The 880 h.p. Mercury engine had to be wound by hand, such effort being required that, in a tropical climate, the average man could not manage more than two or three consecutive winds. The pilot had to remain in the cockpit, and the donkey-work fell to the unfortunate wireless operator. After standing for several hours in 110 deg F the Mercury was no easy starter, and when, as occasionally happened, the wireless operator fell exhausted, it was necessary to obtain V.I.P. assistance. So it came to pass that one day the cranking party consisted of no fewer than two rear-admirals, resplendent in spotless whites and full load of braid! On another occasion a Royal Marine major (having come out to see off his senior officer) unwisely *volunteered* to wind. His effort was crowned with success, but the slipstream was so great that he either dived or was blown into the sea, whence he was



The civil version of the Vickers-Armstrongs Supermarine Sea Otter. The engine is an 805 h.p. Bristol Mercury 30.

Amphibiana . . . . .

fished out, wetter and doubtless wiser, by his own boat.

Wars end, bases are closed and conditions change considerably, but it is reasonable to suppose that there must be many areas in the world where geographical and other factors similar to those described make the amphibian the most convenient form of transport. The three most important factors could, perhaps, be listed as follows:—

(1) The country should be of a mountainous nature, or such that landplanes have difficulty in operating.
(2) Sheltered waters, such as harbours or lakes, must be available.
(3) There must be a strong requirement by the populace for extra-territorial communication.

Three areas may be cited as examples of places in which these conditions are found: Iceland, where a pleasant town like Akureyri in the North has only a monthly link with civilization, in the form of a steamer to Reykjavik, the capital; Northern Canada (its communications are, in fact, already well developed by amphibian and seaplane); and Norway, which, with its long mountainous coastline, should offer tremendous possibilities.

As in the case of landplanes and flying boats, the amphibians at present in the market are of three types: wartime conversions, pre-war types and post-war models.

Wartime Conversion and Pre-war Types.—There are only two British examples and these are our old friends the Walrus and Sea Otter. The latter offers a few advantages over its older brother (in increased size, duration and cruising speed), but it consumes 50 gallons of fuel per hour, which must rule it out commercially except where conditions are exceptionally favourable. Both aircraft, when converted, seat 4-5 passengers, but even the Walrus uses 38 gall/hr for this small payload, so cannot be considered very satisfactory.

America has two well-tried types in the civil and military Grumman Goose and Widgeon. The commercial Goose carries five passengers, with a crew of two, cruises at about 160 kt, and its two P. and W. Wasp Juniors together consume about 30 gall/hr. The Widgeon is smaller, carries four or five all told, and its 400 h.p. engine gives it a surprisingly good performance. Both aircraft have been used in fairly large numbers in the States and, but for the dollar difficulty, would no doubt be well known in Europe.

The Consolidated Cansos, the amphibian version of the Catalina, has recently been converted for civilian use in Canada. It is the largest amphibian in service. Sikorsky produced an 18-seat amphibian before the war, powered by two 750 h.p. P. and W. Hornets. Again its use seems to have been confined to the Western Hemisphere.

New Types

New Types.—The Americans, who have a reasonable home market for civil amphibians, have not unnaturally been first in the field with new designs. Chief amongst these is the Grumman Mallard, an 8-10-seat aircraft powered by two 600 h.p. P. and W. Wasps. With a tricycle undercarriage, a range of 500-700 miles, and a cruising speed of about 160 kt, it appears an attractive proposition. A snag, however, is the price, which at £35,000 seems high for an aircraft of this size.

In the small 2-3-seater class may be mentioned the Goodyear Duck and the Republic Seabee. Both are light aircraft and almost outside the scope of this article, but the Seabee at any rate is being used commercially. Though they are no doubt quite suitable for the sunny waters of Bermuda and Florida, one might entertain doubts as to how they would stand up to choppy take-offs from the Solent or the Clyde. The hammering sustained by a seaplane when it gets on the step in a roughish sea must be experienced to be appreciated. No doubt these little aircraft are pleasant enough when used in their right sphere; it is now known that an Italian charter company is using two Seabees amongst its fleet, and there is no reason why they should not prove their worth on the sheltered Italian lakes.

Britain enters this field with one new type only (if one excludes the purely military Supermarine Seagull). This is the Short Sealand. Although not the first amphibian produced by the Rochester/Belfast firm, it is nearly seventeen years since their last amphibian design—the Gurnard*—was launched and flown. However, their immense combined flying-boat and landplane experience has resulted in the Sealand being an exceptionally promising new arrival. Powered by two 345 h.p. Gipsy Queen 70s, it seats 5-8 passengers and has a mean range with full tanks of about 500 miles and a practical cruising speed of about 155 m.p.h.

As readers are well aware, seaplanes normally lack any form of taxying brake except drogues, which are quite useless in emergency (the author recalls several moments of "panic" when doing initial circuits and bumps in invasion-staked Poole Harbour). The reversible-pitch airscrews fitted to the Sealand will no doubt prove a godsend to pilots operating in confined spaces. This refinement has made it unnecessary to employ a water rudder, so there is an appreciable saving in weight and drag.

The Sealand is a very practical machine. The layout of controls is excellent and mooring operations can be conducted solely by the pilot, who is greatly assisted by the reversing airscrews. The aircraft is to be marketed at something over £23,000, which does not include the cost of radio equipment. It is, of course, arguable that this price may put the Sealand out of the reach of all but the largest concerns.

Latest British Design

The latest British development is one that will constitute good news for all amphibian enthusiasts. This is the Sponson Tribian,† a four-seater land/sea machine in the same class as the Grumman Widgeon. The new aircraft will incorporate many innovations which should make it attractive.

Amphibians almost invariably seem to possess a long and bulky nose (as part of the hull design and to house mooring gear), which makes ground taxying a slow and awkward business. The Tribian will be Britain's first seaplane to be fitted with a tricycle undercarriage, and in consequence the forward view is excellent. As in the Sealand, reversing-pitch airscrews are to be fitted, and mooring can be easily carried out by the pilot alone. The most important innovation, however, is the patent sponson stub wing with "built-in" end floats. This idea is expected to result in a considerable saving of drag as compared with the normal wing-tip float arrangement. An improved hull design will further improve the lift characteristics, so that it is not surprising that the estimated performance figures are, for the first time, comparable with the equivalent landplane. Sponson Developments, Ltd., a small but virile company with headquarters in London, are responsible for the Tribian, and their enthusiasm should do a great deal towards forwarding the cause af amphibian aircraft.

Amphibians that are manufactured and sold in the next two years will no doubt go to distant places in the world, such as the Belgian Congo and Venezuela, where they will be utilized in small numbers for special purposes, e.g., oil survey.

Consider the present and future Empire air routes. Some are flown by flying boats, and recently their service-frequency has been increased by the addition of the new Solents. A short while ago the new Southampton flying-boat terminal was officially opened, and from Saunders-Roe comes information that similar new bases will cost only £80,000 to construct. Again, there is a large and increasing body of opinion in this country which believes that landplanes have reached their ultimate size, in view of the length, thickness and cost of the runways needed to receive them.

Glimpse of the Future

But this is labouring the point. Suffice it to say that flying boats have every prospect of at least holding their own for the next ten years and that Southampton will become an increasingly important air terminal. May there not, therefore, be a requirement for amphibian feeder aircraft to serve passengers bound for centres other than London? Consider a traveller *en route* to Edinburgh or Belfast from Cape Town. He could step straight out from his Solent on to the quayside at Southampton and have his baggage checked and reloaded on to a Sealand standing close by. All aboard, the amphibian would trundle duck-like down the slip, tuck up her legs and be soon airborne and heading north. Our fortunate passenger would find himself at his true destination a couple of hours after first landing on Southampton Water. The advantages are obvious, and the cost need not be more than a 10 per cent charge on the normal fare, an extra which many passengers might gladly pay. Here, then, is an opportunity for market research to investigate a new prospect for British amphibians.

Very little has been said in this article about the light amphibian for the private flier. The reason, of course, is that Britain has practically none, nor are any likely to be made until austerity is behind us. Amphibians are great fun, and offer great opportunities for fishing week-ends and the like. There is a thrill to be obtained from the close intimacy which exists between pilot, aircraft and sea that is found nowhere else except perhaps in the world of sail and power.

* This aircraft was a fleet fighter reconnaissance floatplane with amphibian undercarriage.—Ed.

† Described in "Flight" of July 29th, 1948.—Ed.

Tudor VIII Cabin Boost

Details of the Marshall Supercharger Installation

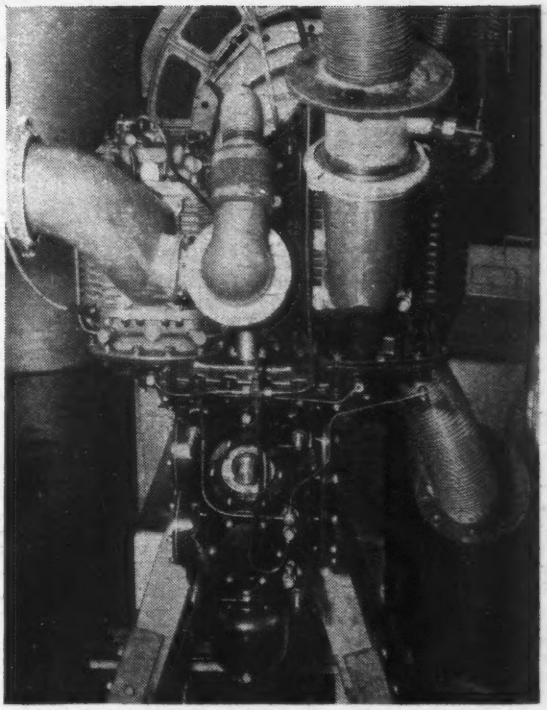
IN the March 24th issue of *Flight*, mention was made of the preliminary and future test programmes of the four-Nene Avro Tudor VIII in relation to the cabin pressurizing system. Further details of the Marshall blowers which sustain cabin pressure are now available and, in that these are the first units of their kind to have been applied for such a purpose, the installation is of considerable interest.

It will be remembered that the four Rolls-Royce Nenes which power the Tudor VIII are installed as pairs in a common nacelle port and starboard. In order that the cabin superchargers in common with the other ancillary services may continue to be driven no matter which engine of either pair may be out of action, the auxiliary gear box in each nacelle is driven jointly by both engines, the transmission system incorporating free-wheel mechanisms so that, with one engine out, the drive is maintained. From the very first inspection of the aircraft, Sir George Godfrey and Partners, Ltd., collaborated closely both with Rolls-Royce and Avros on the cabin blower installation, and an exhaustive series of tests on the blowers was undertaken at the R.A.E.

Each blower unit in each paired engine-nacelle is of two-stage Roots type (designated Marshall 16/40/8) and consists of two coupled blowers mounted vertically on the auxiliary gear box. The first stage blower is a Type 30 Mk 5, and the second stage a Type 15 Mk 8, the former being driven at 80 per cent of the speed of the latter. Total delivery is at the rate of 16 lb of air per minute when the aircraft is flying at 40,000ft, this giving a cabin pressure equivalent to the ambient at 8,000ft.

The inducted air is given to a filter prior to entering the first-stage blower and thence is delivered through a silencer and intercooler to the second-stage blower. Final delivery is made through a further silencer and Normalair spill valve to the aircraft cabin. For operation at lower altitudes, where the full degree of pressurization is not required, the second-stage supercharger is by-passed by means of a non-return valve incorporated between the intercooler and the second stage delivery.

The two-stage supercharger retains most of the inherent advantages of the single-stage Roots type and requires no elaborate control or change-speed mechanism; it is, in addition, very reliable in operation. There has been no difficulty in matching the stages and by virtue of the fact that the volume flow is approximately linearly proportional to speed, the r.p.m. at which the stages are driven is not critical. It is worthy of note that the nominal rating of the Type 15 supercharger was originally 15 lb of air per minute at 25,000ft, so giving cabin conditions equivalent to the ambient pressure at 8,000ft. Now, however, the Type 15 Mk 8 unit (which forms the second stage) delivers 25 lb/min at engine cruising r.p.m. at the same intake and delivery pressures. This example affords some illustration of the development work which has gone into the Marshall cabin blowers.



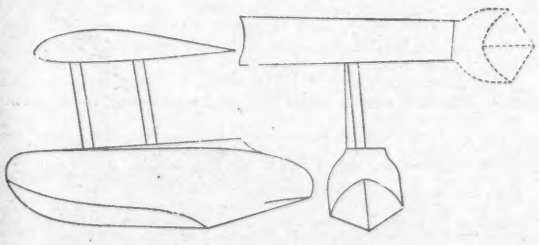
The two-stage Marshall cabin blower on its gearbox mounting.

It has been found that, at extreme altitudes, the ambient temperature may on occasion be as low as −65 deg C, and even at well above this temperature, it is obvious that provision must be made for heating the air delivered to the cabin. There have been many systems devised for meeting this necessity, but the cabin blowers installed in the Tudor VIII may be fitted with a choke and the intercooler provided with gills so that the heat attendant upon air compression may be utilized for cabin heating. Providing that the downstream ducts from the superchargers are lagged, it is considered that this measure should be adequate for meeting most of the cabin-heating requirements.

Progress of the Princesses

PROGRESS with the three large Saunders-Roe flying boats continues according to programme. At the Cowes works the hull of the first *Princess* is plated up to and including some portions of the upper-deck cabins. Plating of hull No. 2 extends to the cabins on the main deck (the SR 45 is a double-decker, it will be remembered), and No. 3 hull has much of the plating fitted to the main deck cabins.

There was some delay originally over wing construction while engine installations were being planned, but the centre section of No. 1 is now being assembled on the jig, with spars and ribs in position and stringers being fitted. The inner main planes have their spars in the jigs, and the ribs are being fitted on them. All spars for centre sections and inner-wing sections for the first three boats have been completed.



How the modified float-retraction is arranged.

A test-rig, actually identical with a portion of one of the inner-wing sections, has been designed and is being built. It will be sent to the Bristol Aeroplane Company, who will install in it a pair of coupled Proteus engines for tests to simulate ground-running on the actual aircraft.

Since the SR 45 design was first put in hand, further consideration has been given to the outboard wing floats. In the original scheme they were to be retracted inwardly and housed in the wing. This arrangement was found to be somewhat heavy, due to the need for transfer of stresses around the float-well in the wing. It has now been decided to swing the floats outwardly so that when raised they lie on their side, with the flat straight deck lying snugly against the square-cut wing tip, as shown in the diagram. The drag is probably not very great in that position, and the estimated saving in weight is in the neighbourhood of 2,000 lb, which will now be available for fuel or payload.

This scheme for retracting wing floats was originally patented by Saunders-Roe in 1928, but was first applied in actual use on the Catalina flying boats.

An Upavon Reunion

No. 38 Group Celebrate

WITH the Chief of Air Staff, Lord Tedder, Lt. Gen. R. N. Gale and Brig. Gen. John B. Ackerman, U.S. Air Attaché among those present, the first reunion of 38 Group, Transport Command, was held at its Upavon headquarters last Thursday.

Reunion dinners should not be, and usually are not, occasions for serious speech-making, and A.V-M. A. C. H. Sharp, D.S.O., A.F.C., the newly appointed A.O.C. (he replaced A.V-M. Fiddament, who returned for the occasion) set the keynote with his amusing welcome to important guests, in which he interposed several personal anecdotes.

General Gale—who raised and commanded the 1st Parachute Brigade, commanded the 6th British Airborne Division and 1st British Airborne Corps, and was a deputy commander of the 1st Allied Airborne Army—gave in the course of his reply a most interesting review of the formation, training, early work and ultimate triumph of the Airborne Forces in the late war. He paid a warm tribute to the mutual co-operation with the American airborne forces, and to the work of the commanding officers in the war period. Speaking of the knowledge and experience which had been gained by the end of the war, he said that he was concerned that it was not being handed on. The gap was growing, and he hoped it would not become too wide. In spite of other priorities there must be some continuity in the work of 38 Group.

Lord Tedder, prevailed upon to speak, picked out points in General Gale's talk on airborne forces and briefly and factually assessed the circumstances and results of outstanding airborne operations, pointing out that these were only employed successfully in the later stages of a war after air superiority had been achieved. If there were to be another war, it would be some time before we should be able to spare resources for airborne equipment. However, the branch would be kept alive in both spirit and material on an important but not on a large scale.

The C.A.S. with A.V-M. Sharp, the A.O.C.

Among the guests at the reunion were the following officers:—

Marshal of the Royal Air Force Lord Tedder, G.C.B., D.C.L., LL.D.; Air Chief Marshal Sir Edgar Ludlow-Hewitt, G.C.B., G.B.E., C.M.G., D.S.O., M.C.; Air Marshal Sir Leslie N. Hollinghurst, K.C.B., K.B.E., D.F.C.; Air Marshal Sir Brian E. Baker, K.B.E., C.B., D.S.O., M.C., A.F.C.; A.V-M. A. L. Fiddament, C.B. C.B.E., D.F.C.; A.V-M. R. Ivelaw-Chapman, C.B.E., D.F.C., A.F.C.; A.V-M. W. L. Dawson, C.B., C.B.E., D.S.O.; A.V-M. P. H. Mackworth, C.B.E., D.F.C.; A. Cdre. W. H. Primrose, C.B.E., D.F.C.; A. Cdre. H. L. Patch, C.B.E.; A. Cdre. P. S. Blockley, C.B.E.; Lt. Gen. R. N. Gale, C.B., O.B.E., M.C.; Maj. Gen A. J. H. Cassels, C.B.E., D.S.O.; Maj. Gen. G. W. Lathbury, D.S.O., M.B.E.; Brig. Gen. John B. Ackerman, U.S.A.F.; Brig. W. Kempster, C.B.E., D.S.O.; Brig. J. H. N. Poett, D.S.O.; Brig. The Lord Tryon, D.S.O.; Brig. G. J. S. Chatterton, D.S.O.; Col. William B. Kieffer, U.S.A.F.; Col. K. T. Darling, D.S.O., O.B.E.; G/C. E. A. Hodgson, C.B.E.; G/C. G. Francis, D.S.O., D.F.C.; G/C. M. H. Kelly, O.B.E.; G/C. G. R. Brice, C.B.E.; G/C. J. M. Cohu, C.B.E.; Lt. Col. C. J. Deedes, M.C.

THE WORK OF THE R.Ae.C

THE excellent work being done unobtrusively by the Royal Aero Club is not always as fully appreciated as it deserves. The chairman's report, read at the annual general meeting last week in Mr. Whitney Straight's absence by the vice-chairman, Mr. Kenneth Davies, served as a useful reminder of the many activities in which the club engages.

In June last year was introduced the R.Ae.C. General Maintenance Scheme for the benefit of private owners. To date 270 copies of the schedules have been applied for, and lately the A.R.B. has approved the inclusion of a twin-engined-aircraft schedule. As a result of the reintroduction of R.Ae.C. approved repairers, no fewer than 70 firms and clubs are now included.

During the year, 763 Customs Carnets were issued, and 158 Acquits. The landing-card scheme met with great approval, and 157 cards were issued in 1948 for airfields under the control of the Aerodrome Owners' Association. For State-controlled airfields the number was even greater: 328 negotiations are proceeding with the Ministry of Civil Aviation concerning bilateral agreements with France, Belgium, the Netherlands, Luxembourg and Switzerland.

During 1948 no fewer than 1,635 Aviators' Certificates were issued, and the total number of Helicopter Certificates has reached 20. Briefing is another of the Club's activities, and it included 37 plans to South Africa, 12 to India and Malaya, and 11 to Australia. Two guides were compiled by the Club: U.K. to South Africa, and U.K. to Australasia. An air-touring guide for Europe is to be issued shortly. The Aeronautical Map Section was very active, the sales covering nearly 16,000 sheets, to a total value of well over £2,000.

Thanks to the generosity of Lord Kemsley in establishing the Kemsley Flying Trust, the Club was able to award grants totalling £17,530 to gliding clubs, flying clubs, the Society of Model Aeronautical Engineers, the Women's Junior Air Corps, and the Ultra-Light Aircraft Association.

R.A.F. SHARE SERVICES RUGBY TITLE

AFTER seeing the Army defeat the Navy few people doubted that such fire and skill would win them the Inter-Services Rugby Tournament for the year. As it turned out, they were in some ways lucky to share the honour with the Air Force, with whom they drew 3 points all at Twickenham last Saturday, March 26th. They had the opportunity to win on penalties alone, but kick after kick was missed. The Air Force on more than one occasion looked like crossing the Army line but were unable to finish off the movements. A drawn game in which the score is composed of two penalty goals does not sound very exciting, nor on the whole was it, and except for a few flashes of brilliance the match did not compare with the earlier Service contests.

The absence of Jackson's tremendously powerful running greatly reduced the danger from the Army line, but the Air Force, too, were short of Young. Uprichard came in at centre, Ross on the left wing and Tucker at stand-off. Roach deputized for Jackson.

Smailes opened the scoring after 30 minutes with a penalty goal, and it was not until well on in the second half that Coutts equalized for the Army. For the R.A.F., Lumsden playing in the centre, as usual did excellent all-round work and Tucker made a favourable impression. Tackling on both sides was very determined, and it was this in the speeded-up period after scores hand been equalized that prevented the try lines from being crossed.

On the whole the R.A.F. forwards did very well, and Weighill, Rossiter and Stirling can be singled out for a mention of their efforts.

The Army: Lt. J. M. H. Roberts; Sgt. A. Roach; Bdr. A. Cameron; Officer Cdt. P. Reeve; Lt. D. W. C. Smith; 2nd Lt. N. M. Hall; 2nd Lt. D. W. Shuttleworth; Maj. P. R. B. Mitchell; 2nd Lt. J. W. Hall; W/O.2 J. D. Clancy; Capt. F. H. Coutts; Maj. B. A. Neale; 2nd Lt. P. M. Young; 2nd Lt. T. R. Marshall; Sglm. R. Cross.

Royal Air Force: F/L. A. A. Smailes; A/C. G. Crerar; F/L. I. J. M. Lumsden; F/L. R. J. H. Uprichard; F/L. R. H. Ross; Cpl. G. R. Tucker; F/L. W. T. H. Hay; F/O. C. M. Browse; A/C. R. Clark; F/L. R. Stirling; F/O. G. G. Farley; Cpl. E. E. Rossiter; F/L. E. L. Horsfall; S/L. R. G. H. Weighill; F/L. H. K. Rees.

AIRCRAFT AND RUNWAY DESIGN

Interesting Complementary Views Given at Joint Meeting of Civil and Aeronautical Engineers

ALTHOUGH for some long time past the Royal Aeronautical Society lectures have been held at the Institution of Civil Engineers, it was not until Tuesday, March 22nd, that the two learned Societies had ever held a joint meeting. Dr. H. Roxbee Cox, President of the R.Ae.S., took the chair and had on his left Mr. Graham Clark, Secretary of the Institution of Civil Engineers, and on his right, Captain Laurence Pritchard, Secretary of the Royal Aeronautical Society.

The occasion was the presentation of two papers, the first, *Aircraft Design with Special Reference to the Restrictions Imposed by Considerations of Airfield Design*, given by Mr. P. H. Watson, B.Sc., A.F.R.Ae.S., of the Directorate of Technical Development, M.o.S., and the second, *The Problem of Airfield Design in Relation to Aircraft Design*, given by Mr. C. E. Foster, C.B.E., B.Sc., A.M.I.C.E., of the Directorate General of Works, Air Ministry. A somewhat unusual procedure was adopted for the meeting, in that each lecturer gave only a summary of his paper, after which four invited speakers contributed comments, these gentlemen being followed by such members of the audience who had discussion points to raise.

MR. WATSON started off by saying that when a new aircraft was being designed, the designer did his best to comply with the "user's" specification, and it was up to the user to decide the routes or airfields for which the aircraft is required. He could do this directly by naming the routes or airfields, or indirectly by stating the maximum permissible wheel loads, tyre pressures and take-off and landing distances.

Marginal Determination

One of the user's problems (continued Mr. Watson) is to decide the margin of runway length required over and above the measured take-off and landing of the aircraft. Experience with Service aircraft has shown that it is necessary to provide an appreciable margin over the customary 50ft-screen clearance distance if the accident rate due to under- and over-shooting is to be kept down to a reasonable level. Runway widths depend mainly on the method of controlling the aircraft during approaches in bad visibility or blind landing conditions, and on the behaviour of the aircraft in cross-wind conditions. They cannot, therefore, be linked directly to aircraft characteristics under the designer's control, although the tendency of tailwheel types to ground-loop or swing places them at a disadvantage in comparison with nose-wheel aircraft.

The aircraft characteristics affected by the number and arrangement of runways are the handling qualities in cross-winds, because there is a limiting cross-wind component for each type which, if exceeded, prevents a satisfactory landing being made. It has been suggested that the use of swivelling undercarriages will enable single runways to be used, but there is no evidence about the increase in permissible cross-wind velocity which would follow their use on modern tricycle types. Swivelling undercarriages would certainly be more useful on tailwheel types than on tricycle aircraft, but experiments made in Great Britain during the war and in the United States more recently, have shown that, although there are no engineering difficulties in providing them, other than some additional weight and complication, the "users" do not seem to want them.

IN the abridged lecture papers and discussion given here the primary factors governing the problems associated with airfield design for heavier and faster aircraft are objectively reviewed. It is an aspect of aviation about which relatively little has been published, but the implications are of such importance that they are, we feel, worthy of closest study.

On the subject of the surfaces of runways and perimeter tracks, Mr. Watson observed that the important characteristic of the surface was its coefficient of friction with aircraft tyres when these were sliding, in that it must be high enough to prevent skidding, but not high enough to cause rapid abrasive wear. When tandem or twin-tandem arrangements of wheels were used, it might become necessary to provide turning places at the ends of runways with hard, smooth surfaces, possibly wetted to keep them slippery, in order to reduce the forces on the landing gear in turns of small radius.

Strength Classification

The strength of runways, perimeter tracks and hard-standings (continued the speaker) is defined by the load on an isolated single-wheel at a specified tyre pressure which can be applied frequently without damage. Two classification schemes are available, viz., that of the I.C.A.O., which defines seven classes of runway, and that devised by the Air Ministry. Both methods used descending scales of single-wheel load and tyre pressure, as illustrated in Fig. 1. The curves in this graph have been based on a method published by the Directorate General of Works, Air Ministry, and show various combinations of single-wheel load and tyre pressure, which have the same effect on runways.

In aircraft design, the arrangement, loading and tyre pressures of the wheels are so closely connected that they must be considered together. They are bound up with the design of the main undercarriages, which weigh between 3½ per cent and 5 per cent of the all-up aircraft weight, only one half of this being due to the wheels and tyres. As the undercarriages weigh nearly as much as one half of the disposable load on long-range aircraft, it is obvious why designers begrudge weight on a component which contributes nothing to performance in the air. Fig. 2 shows how the tyre dimensions adopted in British practice vary with tyre pressure for various wheel loads. British tyre designers have had considerable experience of making tyres for pressures up to 60 lb/sq in, and the characteristics of such tyres are well known. Sufficient experience with pres-

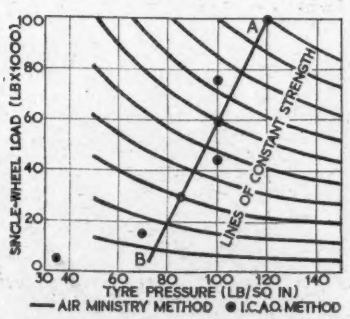


Fig. 1 Air Ministry and I.C.A.O. classifications of runway strength, together with curves of constant strength.

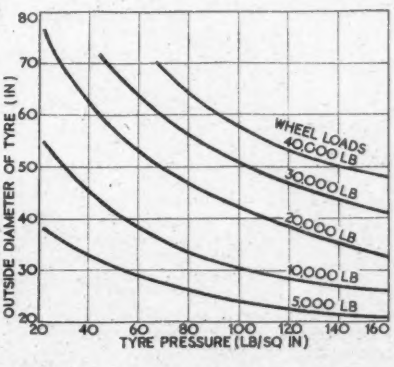


Fig. 2 Variation of tyre outside diameter with tyre pressure for a typically representative selection of wheel-loads.

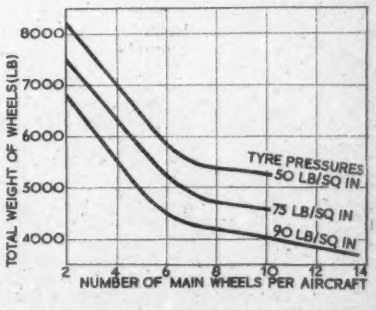


Fig. 3 Variation of total wheel weight with numbers of wheels for various tyre pressures for Brabazon I at an all-up weight of 250,000 lb

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sures between 60 and 90 lb/sq in has been accumulated to justify confidence in them, although at these pressures tyres are more prone to concussion failures and, too, abrasive wear is more rapid. Pressures between 90 and 150 lb/sq in have not been used much in this country, although they have in America, and such tyres are expected to wear still more rapidly and to be still more liable to concussion failures.

The results of several early designs made for the Brabazon I landing gear are summarized in Fig. 3, and it may be seen that the weight of wheels, brakes and tyres is reduced by increasing the number of wheels and by increasing the tyre pressures. In general, it can be shown that higher tyre pressures are better from all points of view except three: (i) the smaller sizes and masses of the wheels increase the difficulties of providing adequate braking; (ii) the wheels sink more easily in soft airfields, with the risk of bogging and increased ground resistance; (iii) the tyres are more difficult to make, the rate of abrasive wear is increased and concussion failures are more likely to occur.

Large Flying Boats

In concluding his lecture, Mr. Watson observed that, in other forms of transport, by road, railways and ships, the adjustments between the vehicles and their surface facilities had been worked out, and the limiting sizes of the figures were known. There seemed little doubt that land-based aircraft would eventually be restricted to suit the dimensions and strengths of runway systems in a similar way, but design had not yet gone far enough to show what the limitations would be. Aircraft might very well follow the lead of surface transport, both by providing the largest aircraft on the North Atlantic run and by developing its largest versions in flying-boat form. As an undercarriage specialist, the author perceived the great advantages of using flying boats, but suggested that his paper was not the place to describe them.

MR. FOSTER introduced his synopsis with the statement that the airfield designer was faced with a problem which was probably unique in civil engineering owing to the fact that, coupled with the enormous weights of present-day aircraft, there had been the tendency to fit smaller wheels for ease of stowage, and these smaller wheels had resulted in higher tyre pressures with correspondingly smaller contact areas. The airfield designer's problem was thus resolved into providing a landing surface for greatly increased weights but with decreased contact areas, resulting in much more concentrated loading.

There is (said Mr. Foster) no Open Sesame to a cheap and rapid method of runway pavement construction; the airfield designer must use the materials common to any similar civil engineering project, namely, concrete and stone, coated with tar or ashphalt, or a combination of these materials. If the cost of airport construction is to be kept within economic limits—as it must be if aviation is to be operated on a commercial basis—there can be no doubt that very serious consideration must be given by the aircraft designer to the problem of modifying his designs so that reduction can be made in the number of runways and the enormous lengths and widths required by the modern aircraft, the dimensions of which have increased concurrently with the increase in weight.

Consideration could be given to the question whether uni-directional runways are a practicable possibility by the use of swivelling undercarriages. Where intensive traffic is expected, two parallel runways could be provided, one being reserved for take-off and the other for landing. The area of land required would thereby be reduced by approximately 50 per cent in comparison with the usual three-runway layout. The widths of runways have now attained 100 yards and this increase does not result so much from the increased span of modern aircraft as from the need for a safety margin required for instrument-approach landings.

Before consideration can be given to the type of pavement required for any specified aircraft load, careful investigation is necessary into the nature and load-supporting qualities of the natural ground on which the pavement is to be laid. In general (continued Mr. Foster), it can be accepted that the heavy loads of modern aircraft involved considerable strengthening of the natural ground if the cost of the pavement is to be kept within reasonable limits. Experience to date has shown that a soil of low bearing quality should be provided with a rigid pavement, such as concrete; on the other hand, it is generally more economical to surface a soil of good bearing capacity with a flexible pavement of the tar-macadam or asphalt variety.

With the object of reducing construction costs, designs have been adopted where the pavement thickness has been varied throughout the length and width of the runway. Having in mind that aircraft normally tend to land down the centre of a runway, the maximum design thickness has been provided over the middle third or half of the width, with a decreased thickness along the margins. A further possible reduction in thickness could be achieved if aircraft could be controlled both in take-off and landing, so that the full length of the runway was always used. The damage is most extensive at the ends and decreases considerably at the centres of the runways.

Cost Proportions

When considering the lower range of wheel loads and tyre pressures, the depth and cost of construction increased in a manner more or less proportionate to the single-wheel load, but with large loads at high tyre pressures, the rate of increase of cost shows a marked upward tendency until it becomes almost prohibitive with some of the existing aircraft types. So far as relief to the pavement is concerned, it can be taken that a 50 per cent reduction in equivalent single wheel load produces approximately the same effect as a 60 per cent reduction in tyre pressure in a single wheel. Since it is possible to obtain the 50 per cent reduction in equivalent single-wheel load by the introduction of a twin-tandem wheel arrangement, it is obvious that the reduction in tyre pressures provides a much less hopeful approach. It has been shown that a significant reduction in equivalent single-wheel load can actually be accomplished by an increase in tyre pressure without very materially altering the effect on the runway. It is thus possible to fit a more compact wheel system.

Since the effect of the loading under each individual wheel of a multiple-wheel undercarriage is, to some degree, affected by the neighbouring wheels, it follows that the maximum relief can be obtained only if very wide wheel spacings are provided in the groups. The effect of wheel spacing has been determined with a number of wheel sizes, and the Brabazon I Mk I arrangement can be taken as a typical example. Normally, this undercarriage supports 135,000 lb on twin wheels at 55in centres. Tests carried out on a concrete pavement designed to support this load show that, if the wheel spacing could be increased by 20in up to 75in, the runway would still be safe with a further 45,000 lb undercarriage load; that is, with a 30 per cent increase in the all-up weight of the aircraft. On the other hand, if the spacing were reduced until the wheels touched each other, the pavement would be suitable to carry only 100,000 lb on the undercarriage; that is, the all-up weight would have to be reduced by nearly 25 per cent.

DISCUSSION

MR. J. A. ROBERTSON, M.I.C.E., of the Air Ministry Directorate of Works, Teddington, the first of the invited speakers, spoke from the civil engineer's point of view and said that in first approaching the problem, the engineer had to decide whether the airfield site was of such bearing quality that only slight protection was required to afford the desirable landing capacity, or whether, on the contrary, elaborate work was necessary. He made the further point that if a runway could be reduced in length by half, the cost was correspondingly reduced, but if, on the other hand, a saving of 50 per cent was made in the strength, this did not provide a 50 per cent saving in cost.

MR. S. SCOTT HALL, M.Sc., F.R.Ae.S., Principal Director of Technical Development (Air), M.o.S., after congratulating the lecturers on their papers, stated that, to-day, the nominal runway length had to be increased to cater for the possibility of landing after engine failure on take-off and, of course, parallel with the rise in speeds has been an increase in the intensity of ground loading. There was now in existence a committee, set up by the four government departments concerned, to enquire into the economics of runway construction.

On the subject of the penalties in air performance which reduction of ground-loading intensity entailed, by virtue of the use of multi-wheel undercarriages and increased tyre sizes, all that could be said was that wing thickness was the one dimension which was likely to be increased in an attempt to ease the runway situation, but that wing thickness was the most critical factor in controlling speed and range.

Mr. Scott Hall deplored the lack of scientific data on the subject of runways, but made the point that it was now recognized that the static weight of the aircraft was a limiting factor rather than the landing impact. In relation to the effects of wing loading and power loading on landing and take-off characteristics, it was true that there had been a steady increase in these loadings in order to keep structure weight and drag down; however, for aircraft designed to operate at high altitudes, the tendency was to keep the wing loading down as much as

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possible. Mr. Scott Hall concluded his contribution with references to the possibilities of rockets for assisted take-off, and braking airscrews and arrester gear for assisting the landing problem: he also made passing reference to mattress landings recently experimented with by the Navy.

MR. J. A. DAWSON, A.M.I.C.E., Chief Resident Engineer at London Airport, agreed with Mr. Foster's contention that the importance of the layout of an airport site as the possible source of the greatest economy in construction could not be too highly stressed. If, for example, uni-directional runways could be employed rather than the tri-directional layout now commonly used, the saving in cost at a terminal of the size of London Airport would run into some millions of pounds.

He thought that Mr. Watson's observations about the possibilities of swivelling undercarriages were disappointing, particularly as the user apparently did not want them, but contrasted this with Mr. Foster's observations that the American C.A.A. are encouraging the idea and that there seemed to be the possibility of development in that direction.

In planning an airport, a cross-wind component was assumed not exceeding 15 m.p.h., but it had recently been found that a new type of heavy aircraft can deal with a cross-wind component of 25 m.p.h. If all aircraft could accept this, the requirements could be met by strengthening one runway instead of two, and the cost of airport construction would not only be very materially reduced, but the whole might be a considerable factor in affecting the cost of air transport.

An increase in the number of landing wheels would permit a great saving to be achieved in the cost of runway construction. It should be remembered that a large number of major airports already existed, and the saving on them would be relatively even greater if equivalent loads could be kept at no more than their present level. It should also be borne in mind that taxying is a costly business and the airport designer should strive to arrange the layout so that taxying could be minimized.

International Aspects

MR. A. E. WOODWARD-NUTT, B.A., F.R.Ae.S., Director, Civil Aviation Research and Development, suggested that the economics of civil aircraft operation were largely influenced by runway considerations of the airline routes and, in that this was an international matter, any amelioration of the situation could only be achieved on an international scale. An attempt was being made at co-ordination through I.C.A.O., and the British delegates at the next meeting were to raise the questions of runway widths and bearing strengths. Reviewing the effects of undercarriage weight, Mr. Woodward-Nutt observed that, in the case of the Brabazon I, if it were possible to eliminate the undercarriage, the revenue-earning capacity of the aircraft would be increased by something like £250,000 per annum.

The speaker then raised some questions arising from what he referred to as his own ignorance of civil engineering: he was disappointed that there appeared to be no Open Sesame to cheap runway construction; he had heard of the proposal to use a water-supported runway, but understood that most civil engineers thought it would be unduly expensive. What form did runway failure take; was there always ample warning, or was there ever sudden failure and what could be done about it? Further, to what extent was runway failure attributable to repeated loadings or duration of loading, and what was the possibility of using, for example, steel plates for hard standings?

The invited speakers having made their points, the meeting was thrown open to general discussion.

MR. F. RADCLIFFE, B.Sc., F.R.Ae.S., A.M.I.A.E. (Handley Page, Ltd.), after saying he wished to endorse Mr. Dawson's remarks, made the point that not only the prime cost of airports throughout the world, but the enormous cost of their maintenance was such as to make necessary a reduction in numbers rather than an addition. He then went on to say that the Americans had recently issued a specification for a long-haul freighter aircraft capable of a range of 2,000 miles with a 15-ton payload and a cruising speed of 300 m.p.h., and capable of operating from runways 4,000ft in length. This aircraft was required to serve small centres of population and to be operable at low cost. Mr. Radcliffe's next remarks were to the effect that the sooner we began a limitation of runway length, the sooner should we get the aircraft which would enable a useful reduction to be made in the present enormous overheads. The ultimate aim would be to have a grass field airport and employ skid-landings; certainly, the idea was a little crude at the moment, but with a little ingenuity there was no doubt that we could get some way towards that object.

Mr. Radcliffe asked for enlightenment on precisely how the vertical velocity in landing was determined in this country and in America, and put in a plea for more attention to be paid to the design of high-lift wings as a means of assisting the reduction in airfield requirements.

MR. H. G. CONWAY, M.A., F.R.Ae.S., A.M.I.Mech.E. (British Messier) spoke from the point of view of the undercarriage designer, and said that there was very little precise information as to what did, in fact, happen on the runway. He then quoted some interesting examples illustrating the intensity of use to which the runway at Gatow has been subjected during the Berlin Air Lift, and the manner in which it has behaved. In one week, the runway sustained as much wear as did that of a bomber station during the war. When the DC-6 Globemaster was used at Gatow, it so damaged the runway that, after 23 landings, the aircraft had to be withdrawn; Mr. Conway thought that facts such as these were of more import than most that had been presented during the meeting.

On the subject of tyre damage and pressures, he stated that, in view of the fact that most tyres failed due to cuts, American practice was now to employ ribbed treads rather than patterned types. Experience with high-pressure tyres was well advanced in America and, to cite but two examples, the B-45 tyres are inflated at 200 lb/sq in, whilst those of the B-36 used 180 lb/sq in.

Mr. Conway confirmed that the C.A.A. were sponsoring the development enquiry into swivelling undercarriages but, so far as he knew, this was confined to tailwheel layouts and no comparable work had been done with nosewheel configurations. He then raised the point that the stowage problems of multi-wheel undercarriages could be complicated by the need to rotate the bogie relative to the leg if forward or rearward retraction was employed.

Present Runways for Future Types

MR. C. DYKES, A.F.R.Ae.S. (B.O.A.C.), in acknowledging his appreciation of the papers, said he was glad to see that the authors both agreed that the problem was chiefly the operators'. B.O.A.C. were laying down aircraft which would not be in use for six or seven years and they were quite unable to wait for the results of runway bearing tests which were now taking place. In addition, they could not see any way of influencing other countries to put down new runways or to strengthen existing runways to the required bearing values.

MR G. V. KIBBLEWHITE, M.I.C.E., in a contribution leavened with deft humour, suggested that, from his own experience of how an aircraft could bounce and keep on bouncing before finally landing (and, too, in order to cater for the possibility of engine cut during take-off), Mr. Foster's suggestion of reduced runway thickness towards the centre portion of the length might well be dangerous. Mr. Kibblewhite made the point that the virtue of great exactness in calculation could be negatived by the untoward emergency occurrence, and then went on to state that he viewed the experimental use of a post-stressed, pre-cast runway at Orly, Paris, as being of considerable interest; he was especially pleased to see that an experimental section similar to that at Orly is to be constructed and tested in Great Britain. He thought that a concrete runway of 2½ft thickness was not something of which a civil engineer could deservedly be proud.

DR. ROXBEE COX then concluded the discussion with some observations of his own. He thought that it had been made very clear that the trouble lies with ever-increasing size in aircraft. Mr. Scott Hall had made some advanced suggestions, but he (Roxbee Cox) could not feel altogether comfortable about the use of rockets for passenger-carrying commercial aircraft, nor about such devices as mattresses and arresting gear for relieving landing problems. He felt that confidence in air travel would not be increased by such devices and that a simpler and more radical solution to the problem should be sought. Mr. Woodward-Nutt had made a very illuminating remark in his reference to the suggestion for supporting the runway on water. "He had got the solution," stated Dr. Roxbee Cox, "that is, to support the aircraft on water." It was obvious that runways and airports would continue to be necessary for aircraft up to a certain size, but if we insisted upon having aircraft above that given size, then the simplest solution is to operate them from that material which is free, of infinite bearing capacity and which covers two-thirds of the area of the globe —water. What it amounted to was that if we had to build very large aircraft, would it not be better to avoid the critically high tyre loads by making those aircraft flying boats?

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

V.R. RECRUITING

An Untapped Source?

I OFTEN wonder why the Air Ministry is so reluctant to use the young men who were accepted for aircrew training during 1944-45 and eventually did their National Service in other branches of the Forces. Many of these men are still keen and would welcome the opportunity to join the R.A.F.V.R. for flying training at week-ends. Is the Air Ministry afraid of the effect of such a scheme on its recruiting drive?

K. J. SIBLEY,
Windsor. Ex-A/C.2.

TOOLS FOR THE JOB

New R.A.F. Kit

IN a letter in your issue of March 10th, Mr. D. Chisholm, ex-Sgt. Fitter, criticizes the tool-kits issued to the technicians in the R.A.F. Regarding the tools we used to have I quite agree with him, but I feel I must point out to him that a new tool-kit, now being issued, is more in keeping with the work done. It was described in a recent issue of the *R.A.F. Review*.

HALTON APPRENTICE.
Halton, Bucks.

SOARING FLIGHT

The Technique of Storks

YOUR correspondent, Mr. C. H. A. Johnson (March 17th) is surely incorrect. The stork was, in effect, catapulted at 15 m.p.h. It flapped its way to 50ft. The still-air speed was therefore 15 m.p.h., plus speed gained on climb. From that point onwards the speed of the wind has absolutely no relationship to the height subsequently gained by the free ride. This height would be gained even if during the free ride the wind speed increased to 60 m.p.h., or decreased to 0 m.p.h.

The only explanation I can offer is that the storks used an elliptical circuit because of an oddly shaped thermal.

Leuchars, Fife. W. A. McCORQUODALE.

PIONEER SQUADRONS

No. 3 Sqn. Aircraft and Markings

MAY I point out two small errors in the otherwise admirable article on No. 3 Fighter Squadron in your issue of March 17th? The assertion that No. 3 Sqn. was the only R.A.F. unit to be equipped with the Hawker Woodcock is not correct. During the joint occupation of Upavon by Nos. 3 and 17 (F) Sqns. before their move to Kenley and re-equipment with Bulldogs, both these squadrons were equipped with Woodcocks.

Many readers will doubtless recall the familiar black and white zig-zag squadron insignia of No. 17's Woodcocks, a marking which was later to become even more famous on the Bulldogs.

My other point concerns the Hurricane shown on page 318. The artist is surely in error in showing this aircraft with roundels *circa* 1938 and the fuselage band in addition? The duck-egg tail band was only introduced in 1940 and, if shown, should be accompanied by the fin flash which was introduced shortly before.

OWEN C. THETFORD.
Leighton Buzzard, Beds.

Some Recollections of Nos. 2 and 3

IT is obvious from the letters of S/L. G. Collinson and "Air Gunner" in your Correspondence columns of March 17th that both No. 2 and No. 3 Squadrons were equipped simultaneously with heavier-than-air machines and are therefore both primary squadrons of the Royal Flying Corps. No. 2 was termed an Artillery Observation Squadron and No. 3 became a Scout Squadron. The word "scout" is a cavalry term, as is "squadron." The Royal Flying Corps was organized on cavalry lines and was supposed to perform the work of flying cavalry which were always the advanced screen for an advancing army. First the cavalry scouts were sent forward to contact the enemy and then the cavalry made their charges as required, after which the main body of the army came up into battle. That was normal army procedure. To-day the air arm and the armoured cars have replaced the horse cavalry.

I was posted to No. 2 Squadron in June, 1916, became a Flight Commander, and was shot down on December 27th. Our machine then was the B.E.2C, with 90 h.p. vee-eight air-cooled engine designed by the Royal Aircraft Factory. The Squadron was afterwards equipped with the R.E.8.

In your review of No. 3 Squadron you do not mention the Morane Bullet which was a mid-wing fighter monoplane. My brother was posted to that squadron for a short time to fly them, but they were under-engined and under-winged and crashed too easily. However, he flew them quite succssfully until, after crashing two in one day and then asking for another, he was told that it had been decided to wash them out as so many pilots had been killed on them. He then came to No. 2 Squadron as Flight Commander, but after a couple of months was shot through the thigh in a fight with two E/As. He shot one of the E/As down and the other escaped. He was awarded the M.C. for this and other good work—photography, bombing, etc.

By the way, it was General Sir Douglas Haig who originally discovered the value of aircraft in war, during the retreat from Mons. A pilot kept landing alongside his H.Q. in a field and telling him exactly what the enemy were doing, where they were advancing, etc. He was then in command of an Army Corps, and this experience made him urge the necessity for more air squadrons. He was the man who really made the Royal Flying Corps.

J. B. GOULD,
Westcliff, Essex. Major.

NEW TRAINERS

The Chipmunk too Elementary?

FOR the past few months I have read with interest the correspondence and articles which have had as their subject the present conditions and future prospects of the R.A.F. A considerable part of the early correspondence, it will be recalled, was devoted to the R.A.F.V.R. The possible need for reorganization in some sections was stressed, and the certain need for re-equipment was mentioned.

Having followed your story, I was almost amazed to read of your joyful welcome to the Chipmunk as the replacement aircraft for the V.R. Certainly the Tiger's days are over, but surely this new product is not the answer to the replacement question in the modern Reserve. Since this aircraft has come from such a famous and well-tried stable, it will doubtless be a fine little machine, and I fear that, if a disastrous Third World War does not intervene, it will be flogged for another twenty years as the "basic" trainer. It may do a grand job of accompanying pupils on their first solos, or it may, with the aid of overdue subsidies, form a backbone for our struggling flying clubs; but what exactly have these jobs in common with the post-war V.R.?

From what I hear in conversation I am one of the V.R.'s junior flying members with about 550 hours, but even at this stage, in what I hope will be a long V.R. career, I do feel, along with many others, that something more advanced could be tackled without too great a risk of breaking something.

The idea is held that "Tigers keep your hand in," but they are so very different from even an old "Spit" that I rather doubt whether present V.R. members would cope at an O.T.U. any better than chaps who never touched the controls after 1945. Will the Chipmunk help us any more than the Tiger? Together with many others, I doubt it.

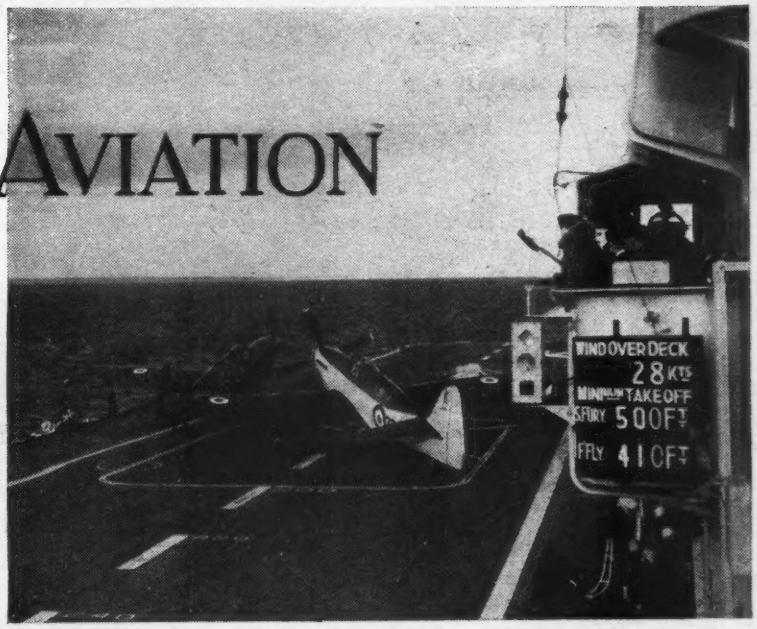
Quite obviously there just aren't enough people in a position to give their services for the maintenance of a modern Service type. V.R. ground-crew recruiting is unlikely to supply the demand for the highly skilled tradesmen who are essential to the keeping of a considerable number of aircraft in the air.

But taking the foregoing paragraph into account, there is a huge gap between Chipmunks and "Spits" (or "Wimpeys"). Surely the well-tried Harvards and Masters could be made available in sufficient numbers to train the V.R. on a truly *Reserve* footing. The V.R. is composed of a highly experienced nucleus of pilots surrounded by a not so experienced body of keen pilots, and I do sincerely feel that we are deserving of something better than flying-club aircraft.

London, E.11. R. D. WOOD,
F/O.

SERVICE AVIATION

Royal Air Force and Naval Aviation News and Announcements



FINAL PREPARATION : Two Fireflies of No. 20 Carrier Air Group taxi into take-off position aboard H.M.S. Sydney during its recent working-up trials off the coast of Scotland. This first Australian carrier is due to sail shortly for the Commonwealth.

R.A.F. Rescue

DAKOTAS and a Sunderland from Air Command, Far East, have completed the evacuation of several hundred British nationals, considered to have been in danger during fighting between Burmese Government forces and Karen insurgents.

The first evacuation was by a Sunderland which alighted on the Irriwadi at Rangoon at dawn on February 23rd with 19 women, 15 children and six men from the Chauk area. Five Dakotas, some carrying emergency food supplies flown from Singapore, stood by on the airfield at Mingaladon, near Rangoon, and a second Sunderland was in readiness at Koggala. Two Dakotas dropped food supplies for the British personnel at Maymyo.

On the first day on which Anisakan airfield could be used 47 women and children were flown to Rangoon. On the second day, however, the local Karen commander (Brig. Chit Khin) refused to allow further evacuation unless the family of one of his generals (Gen. Smith Dun) could be flown from Maymyo to Myitkyina, and in return he agreed that the family of a Burmese brigadier (Brig. Kyaw Zaw) should be flown from Maymyo to Rangoon. This was agreed to by both sides and the R.A.F., the Burmese Prime Minister assenting on condition that a neutral observer—an Indian—should also fly in the aircraft.

Evacuation continued and by the third day 167 persons had been flown to Rangoon, with 13,000 lb of personal baggage. A Catalina made further evacuations from Amoy and Mandalay. From Rangoon most of the evacuees were flown to Penang (Malaya) and then, on a third stage, to Singapore.

Auxiliary Squadrons Move

A LINK with the past was broken last Sunday when, after a final briefing at their old station, Nos. 601 (County of London) and 604 (County of Middlesex) Squadrons flew their Spitfire 16s and Harvards from Hendon to North Weald. The move was occasioned by the forthcoming re-equipment of the two Squadrons with jet fighters, for which the Hendon runways are insufficiently long.

At North Weald, the runways are now being extended, and this pre-war two-squadron fighter station has ample accommodation for both men and aircraft. The transfer was watched by G/C. J. H. McC. Reynold, the Senior Air Staff Officer to No. 65 (London Reserve) Group.

With the two R.Aux.A.F. Squadrons absent, Hendon will house only the H.Q. of No. 65 Group and certain Transport Command units. The modern aircraft has outgrown this famous airfield, and it is difficult to realize that 36 years ago machines not only took-off, but also flew complete races inside the perimeter.

"Flight" photograph.

MIGRATION : Pilots of No. 601 Squadron with one of their Spitfire 16s. As related on this page, the Squadron lately flew from Hendon to its new base at North Weald.

R.A.F. Appointments

FORMERLY Senior Technical Staff Officer of Air Command, Far East, A. Cdre. A. F. Hutton, C.B.E., D.F.C., has been appointed Director of Engineering at the Air Ministry, in place of A. Cdre. G. B. Beardsworth, C.B., who becomes Senior Technical Staff Officer at Fighter Command H.Q. A. Cdre. N. S. Allinson, C.B., who spent last year at the Imperial Defence College, has taken over command of the Rhodesian Air Training Group.

A previous holder, for Great Britain, of the world's altitude record, A. Cdre. F. R. D. Swain, C.B.E., A.F.C., has been appointed A.O.C. No. 28 Group. As a Squadron Leader attached to the R.A.E., Farnborough, in 1936 he flew the experimental Bristol 138 to a height of 49,944 feet.

Appointed to succeed A. Cdre. R. B. Jordan, C.B., D.F.C., as A.O.C. Gibraltar, is A. Cdre. G. R. C. Spencer,

Service Aviation . . . . .

C.B.E., formerly Director of Air Force Welfare, before which he commanded the Central Bomber Establishment for two years.

Ninth Anniversary

THIS year's Battle of Britain Week, to be observed from September 12th to 18th, will be celebrated in the usual way, with colour-hoisting parades and other ceremonies at all R.A.F. stations. The R.A.F. "At Home" day will be Saturday, September 17th, when a number of stations will be opened to the public, and on the following day (Battle of Britain Sunday) there will be thanksgiving services.

Auxiliary Appointment

ONE of the Royal Auxiliary Air Force's two jet-fighter squadrons—No. 500 (County of Kent)—is to be commanded by W/C H. C. Kennard, D.F.C., who succeeds S/L. P. Green, O.B.E., A.F.C., taking the same R.Aux.A.F. rank. W/C. Kennard was granted a short service commission in September, 1938.

He spent the first three years of the war on operational flying, and was awarded the D.F.C. in June, 1942, after completing 52 sorties since taking command of No. 121 (Eagle) Squadron at the beginning of the year. No. 500 Squadron flies Meteor 3s from West Malling, near Maidstone.

Radio Inspection

THE Lancaster *Iris*, of the R.A.F. Inspectorate of Radio Services, left Lyneham on March 17th for a 20,000-mile four-week tour of R.A.F. stations in the Middle and Far East. A.V-M. E. B. Addison, Director-General of Signals, was due to join the party on March 27th at Negombo (Ceylon) on the outward flight, remaining with the aircraft until its return to Lyneham on April 14th.

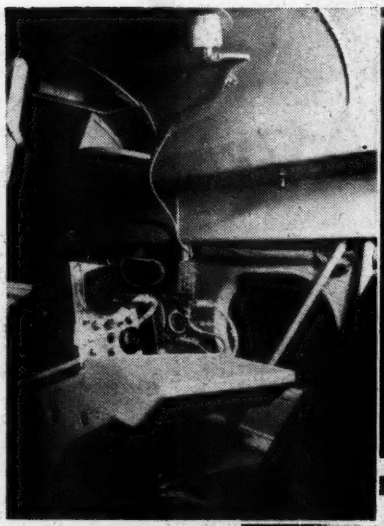
Checks are being made on radio aids to navigation and communications at the overseas stations and at those en route, and R.A.F. signals centres are being inspected. Transmissions from R.A.F. ground stations are being recorded in the *Iris* and later played back to the ground operators. This enables operators and controllers to hear how their messages are received in the air and gives them an opportunity to notice and correct any minor faults which may have developed in their technique.

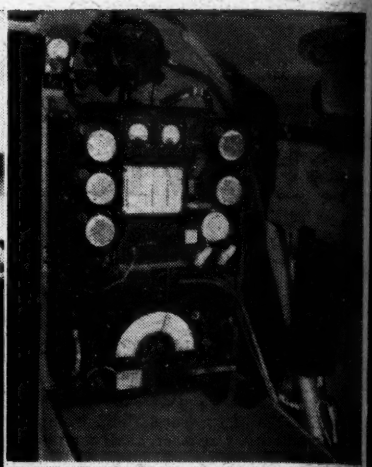
Some 16 R.A.F. stations, including Negombo, Butterworth (Malaya), Tengah (Singapore), and Kai Tak (Hong Kong) are taken in by the tour. G/C. B. H. Boon, Inspector of Radio Services, is in charge of the tour, and the aircraft, which has a crew of five, is captained by F/L. E. Stone, D.F.C. Since May, 1947, *Iris* has made five similar overseas tours, flying a total of 170,000 miles, and visiting 104 airfields in 28 countries.

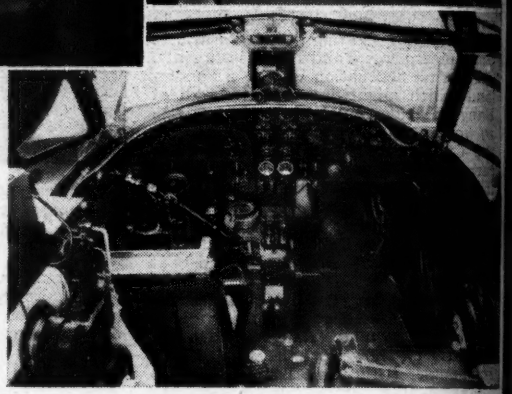
Memorial-Window Booklet

EACH of more than 250 guests who attended the unveiling ceremony of the Battle of Britain Memorial window at the Rolls-Royce works at Derby is to receive a souvenir booklet describing and illustrating the event. The booklet is finely bound and printed on art paper, and a colour reproduction of the window forms the frontispiece.

As there is believed to be a demand for such a record not only among pilots and Rolls-Royce workers, but also from relatives of those who died in the Battle of Britain, it has been decided to make the brochure available to the public at a nominal price of 2s 6d, and the total sum realized will be handed over to the R.A.F. Benevolent Fund. Applications should be addressed to Rolls-Royce, Ltd., Derby.







AIRCREW TRAINER: *Latest versions of the Anson are characterized by very comprehensive equipment. Two interior views of the T.22 radio trainer above show the pupil's Gee station (left) and the pupil/radio-operator's position (top right), which is provided with a T.1154 transmitter, R.1155 receiver, J-type aerial selector, morse key and control panel. The well-equipped cockpit of the Anson T.20 navigational trainer is shown on the right.*

44 Group Dinner

THE first reunion dinner of No. 44 Group and O.A.C. Gloucester, held recently in London, was attended by 57 officers. The chairman, A.V.-M. E. Kingston McLoughry, C.B.E., D.S.O., D.F.C., who was the Group's A.O.C. from 1941 to 1943, welcomed the guest of honour, Maj.-Gen. Leon W. Johnson, Commander of the Third Air Division, U.S.A.F., whose associations with 44 Group began during the war.

Following this first highly successful affair, it is hoped that the reunion will be held annually. Ex-members are asked to contact the organizing secretary, C. A. Riceman, Room 504, 19-29, Woburn Place, London, W.C.1.

Permanent Commissions

GENERAL DUTIES BRANCH

Squadron Leaders: C. J. Frith, J. R. Wood, D.F.C.

Flight Lieutenants: W. F. Barker, G. Bates, D.F.C., S. Halliwell, D.F.C., F. S. Hazelwood, K. A. Hutchings, P. A. Knapton, D.F.C., J. Mellor, B. W. Parsons, W. M. Robinson, H. C. W. Spackman, F. C. Wilson.

Flying Officers: F. W. J. Davies, M. A. McNeile, J. R. Wilcock.

TECHNICAL BRANCH

Flight Lieutenants: S. E. Cowles, J. Elliott, J. D. Girvan, B. F. C. Lynes, L. A. Marland, P. S. Mills, L. R. Spinks.

Flying Officers: W. Adams, C. B. Budd, J. Syme.

EQUIPMENT BRANCH

Flying Officer: R. G. Proctor.

SECRETARIAL BRANCH

Flight Lieutenant: C. W. P. Lishman.

R.A.F. REGIMENT

Flight Lieutenant: J. L. Mill.

AIRCRAFT CONTROL BRANCH

Flight Lieutenants: G. R. Duff, A. R. D. Maconochie.

MEDICAL BRANCH

Flight Lieutenant: H. Wainstead, M.R.C.S., L.R.C.P.

EDUCATION BRANCH

Flight Lieutenant: A. C. Kerr, M.A.

Pilot Officer: D. J. Cockrell, B.Sc.

PROVOST BRANCH

Flight Lieutenant: F. W. Wallis.

Reunions

A REUNION for all ranks of No. 267 Squadron, Transport Command, will be held at the Chez Auguste Restaurant, 47, Frith Street, London, W.1, on Saturday, June 18th, at 6.30 p.m. Tickets (9s) from R. Bramer, 6, Fair Oaks Place, Chobham, near Woking, Surrey.

* * *

Subject to the reception, by May 15th, of at least 75 enquiries, the third reunion dinner for R.A.F. and W.R.A.F. officers who served in No. 206 Group, Med./M.E., will be held at the Holborn Restaurant, London, W.C.1, on Saturday, June 18th, at 6.30 p.m. for 7 p.m. Requests for tickets (15s) should therefore be made as soon as possible to G/C. B. L. Blofeld, Room 537a, Adastral House, Kingsway, W.C.2.